Southern Pine Manual

of

Standard Wood Construction

Southern Pine Association
New Orleans, La., U.S.A.

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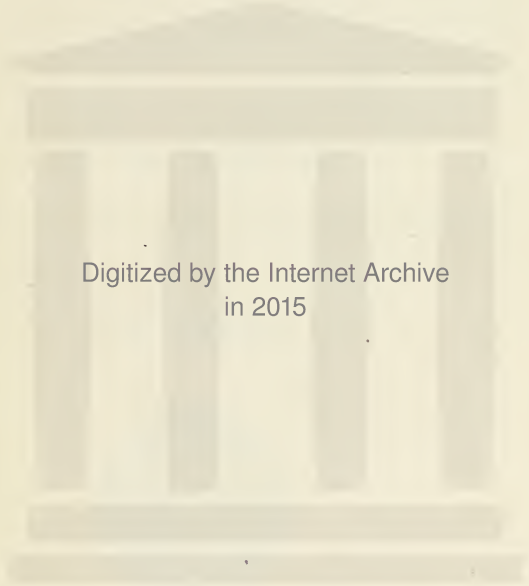

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Southern Yellow Pine

A Manual of

Standard Wood Construction

8th Edition

Southern Pine Association

New Orleans, La., U. S. A.

1920

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SOUTHERN PINE ASSOCIATION

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PREFACE

Eighth Edition
1 9 2 0

The excessive demand on the part of Architects and Engineers for the *Seventh* Edition of the Southern Pine Manual of Standard Wood Construction has made necessary the publication of this *Eighth* Edition.

Except for minor changes in wording found in the non-technical portions of the Seventh Edition, the entire text of the Seventh Edition has been retained in the new edition. Owing to the necessity for certain additional data for use in designing composite and all-wood structures, the following additional matter has been added:

(a) Weights and dimensions of bolts and nuts.

(b) Properties of structural steel shapes.

(c) Minimum live floor loads for structures of various purposes.

(d) Safe column loads.

(e) Trigonometric formulas and solution of triangles.

(f) Mensuration—(Surfaces, and Volume of Solids).

(g) Functions of numbers 1 to 500 (squares, cubes, square roots, cube roots, and logarithms).

(h) Natural sines and cosines, tangents and cotangents.

(i) Logarithmic functions (sines, cosines, tangents and cotangents).

(j) Sheet-piling.

(k) Lattice trusses.

(l) Design of Howe roof trusses.

Grateful acknowledgment is made of the permission extended by the Carnegie Steel Company and the F. Hodgman Company to use portions of the texts from their publications in compiling the text for the new edition.

May, 1920 SOUTHERN PINE ASSOCIATION

TABLES OF DIMENSIONS

AND PROPERTIES OF YELLOW PINE BEAMS, MILL AND LAMINATED FLOORS

(Actual size and thickness)

The name or designation of a timber is given in the terms of its size, and the size is indicated by the breadth and depth of the section in inches. For example, we say or write "6x10" by a variable length which indicates that the timber in section is 6" in breadth by 10" in depth by a variable length. "6x10" is the name which describes and appertains to that particular section.

The term "nominal size" indicates the name of the section. Lumber is sold on the basis of the contents of the nominal size expressed in terms of board-feet. A board foot is the contents of a volume 12"x12"x1", 144 cubic inches and 1/12 of a cubic foot.

The term "actual size" indicates the size of the dressed timber and these sizes are dressed as indicated in column 3. "S1S1E" indicates that the piece is "dressed on one side and one edge," "S4S" indicates that the piece is "dressed on four sides."

The weight of the section is based on a weight of 40 pounds per cubic foot.

The moment of inertia and section modulus are with the neutral axis perpendicular to the depth at the center.

The coefficients of strength, for the various fibre stresses as indicated, are the safe loads in pounds uniformly distributed, including its own weight, for a beam one foot long. Thus the safe load for any span is obtained by dividing the proper coefficient by the length of the span in feet.

To select a beam to support a given uniformly distributed load on a given span, find the coefficient of strength required and refer to the tables for a beam having a coefficient of that value with the required fibre stress. The coefficient required is found by multiplying the uniformly distributed load in pounds by the span in feet. If the load is concentrated at the center of the span, the safe load is one-half the safe uniformly distributed load for the same span. To select a beam for supporting a load concentrated at the center of the span, multiply the given load by 2 and consider the result as a uniformly distributed load. If two equal concentrated loads are applied at the third points of the span the safe load is three-fourths of the uniformly distributed load for the same span. To select a beam for equal loads concentrated at the third points of the span, multiply the sum of the loads by 1⅓ and consider the result as a uniformly distributed load.

If the load or loads are not applied as above described the bending moment must be applied as explained on pages 57 to 72 inclusive.

In case of short beams the resistance to the horizontal shearing stress may limit safe allowable load on the beam or determine the selection of a beam for supporting a given loading. These limitations are given and explained on pages 36 and 37.

The coefficient of deflection is the deflection in inches of a beam one foot long with a uniformly distributed load of 1,000 pounds. The deflection of a beam of any span and uniform load is obtained by multiplying the proper coefficient by the cube of the span in feet and by the number of 1,000-pound units in given load. For a concentrated load of 1,000 pounds applied at the center of the span the coefficient for such loading is 1.6 times the given coefficient. For a load of 1,000 pounds applied at the third points of the span in 500 pound units the coefficient for such loading is 1.36 times the given coefficient.

PROPERTIES OF YELLOW PINE BEAMS

(Actual size)

1	2	3	4	5	6	7
Nominal Size	Actual Size	Dressed	Area of Section bd.	Weight per Foot	Moment of Inertia $bd^3/12$	Section Modulus $bd^2/6$
			A		I	S
			Sq. Ins.	Pounds	Inches^4	Inches^3
2 x4	1 5/8x3 5/8	S1S1E	5.89	1.63	6.45	3.56
4 x4	3 5/8x3 5/8	S1S1E	13.14	3.64	14.39	7.94
4 x4	3 1/2x3 1/2	S4S	12.25	3.40	12.50	7.15
2 x6	1 5/8x5 5/8	S1S1E	9.14	2.53	24.10	8.57
2 1/2x6	2 1/4x5 1/2	S1S1E	12.37	3.43	31.18	11.34
3 x6	2 3/4x5 1/2	S1S1E	15.12	4.20	38.13	13.86
4 x6	3 5/8x5 5/8	S1S1E	20.39	5.65	53.76	19.12
6 x6	5 1/2x5 1/2	S4S	30.25	8.38	76.25	27.73
2 x8	1 5/8x7 1/2	S1S1E	12.19	3.38	57.13	15.23
2 1/2x8	2 1/4x7 1/2	S1S1E	16.87	4.68	79.10	21.10
3 x8	2 3/4x7 1/2	S1S1E	20.62	5.72	96.68	25.78
4 x8	3 3/4x7 1/2	S1S1E	28.12	7.80	131.83	35.16
6 x8	5 1/2x7 1/2	S1S1E	41.25	11.43	193.36	51.56
8 x8	7 1/2x7 1/2	S4S	56.25	15.58	263.67	70.31
2 x10	1 5/8x9 1/2	S1S1E	15.44	4.28	116.10	24.44
2 1/2x10	2 1/4x9 1/2	S1S1E	21.37	5.92	160.76	33.84
3 x10	2 3/4x9 1/2	S1S1E	26.12	7.24	196.48	41.36
4 x10	3 3/4x9 1/2	S1S1E	35.62	9.87	267.93	56.41
6 x10	5 1/2x9 1/2	S4S	52.25	14.47	392.96	82.73
8x 10	7 1/2x9 1/2	S4S	71.25	19.74	535.86	112.81
10x10	9 1/2x9 1/2	S4S	90.25	25.00	678.75	142.89
2 x12	1 5/8x11 1/2	S1S1E	18.69	5.18	205.95	35.82
2 1/2x12	2 1/4x11 1/2	S1S1E	25.87	7.17	285.16	49.59
3 x12	2 3/4x11 1/2	S1S1E	31.62	8.76	348.53	60.61
4 x12	3 3/4x11 1/2	S1S1E	43.12	11.95	475.27	82.66
6 x12	5 1/2x11 1/2	S4S	63.25	17.52	697.07	121.23
8 x12	7 1/2x11 1/2	S4S	86.25	23.89	950.55	165.31
10 x12	9 1/2x11 1/2	S4S	109.25	30.26	1204.03	209.39
12 x12	11 1/2x11 1/2	S4S	132.25	36.63	1457.51	253.48

PROPERTIES OF YELLOW PINE BEAMS

(Actual size)

8	9	10	11	12	13	14
COEFFICIENT OF STRENGTH.						Coefficient of Deflection Uniform Load Inches
Fibre Stress 1200 Pounds Per Sq. In.	Fibre Stress 1300 Pounds Per Sq. In.	Fibre Stress 1400 Pounds Per Sq. In.	Fibre Stress 1500 Pounds Per Sq. In.	Fibre Stress 1600 Pounds Per Sq. In.	Fibre Stress 1800 Pounds Per Sq. In.	
C12	C13	C14	C15	C16	C18	N
2848	3085	3322	3560	3797	4272	.0021533
6352	6881	7410	7940	8469	9528	.0009652
5720	6197	6673	7150	7627	8580	.0011106
6856	7427	7999	8570	9141	10284	.0005763
9072	9828	10584	11340	12096	13608	.0004458
11088	12012	12936	13860	14784	16632	.0003643
15296	16571	17845	19120	20395	22944	.0002583
22184	24033	25881	27730	29579	33276	.0001821
12184	13199	14215	15230	16245	18276	.0002431
16880	18287	19693	21100	22507	25320	.0001756
20624	22343	24061	25780	27499	30936	.0001437
28128	30472	32816	35160	37504	42192	.00010535
41248	44685	48123	51560	54997	61872	.00007183
56248	60935	65623	70310	74997	84372	.00005268
19552	21181	22811	24440	26069	29328	.0001197
27072	29328	31584	33840	36096	40608	.0000864
33088	35845	38603	41360	44117	49632	.00007069
45128	48889	52649	56410	60171	67692	.00005184
66184	71699	77215	82730	88245	99276	.00003534
90248	97769	105289	112810	120331	135372	.00002592
114312	123838	133364	142890	152416	171468	.00002046
28656	31044	33432	35820	38208	42984	.00006744
39672	42978	46284	49590	52896	59508	.00004871
48488	52529	56569	60610	64651	72732	.00003985
66128	71639	77149	82660	88171	99192	.00002922
96984	105066	113148	121230	129312	145476	.00001993
132248	143269	154289	165310	176331	198372	.00001461
167512	181471	195431	209390	223349	251268	.00001154
202784	219683	236581	253480	270379	304176	.00000953

PROPERTIES OF YELLOW PINE BEAMS

(Actual size)

1	2	3	4	5	6	7
Nominal Size	Actual Size	Dressed	Area of Section bd.	Weight per Foot	Moment of Inertia $bd^3/12$	Section Modulus $bd^2/6$
			A		I	S
			Sq. Ins.	Pounds	Inches^4	Inches^3
2 x14	1¾x13½	S1S1E	23.62	6.55	358.80	53.16
2½x14	2¼x13½	S1S1E	30.37	8.41	461.32	68.34
3 x14	2¾x13½	S1S1E	37.12	10.28	563.84	83.53
4 x14	3¾x13½	S1S1E	50.62	14.02	768.87	113.91
6 x14	5½x13½	S4S	74.25	20.57	1127.67	167.10
8 x14	7½x13½	S4S	101.25	28.05	1537.73	227.81
10 x14	9½x13½	S4S	128.25	35.53	1947.80	288.56
12 x14	11½x13½	S4S	155.25	43.00	2357.86	349.31
14 x14	13½x13½	S4S	182.25	50.48	2767.92	410.06
2 x16	1¾x15½	S1S1E	27.12	7.51	543.06	70.10
2½x16	2¼x15½	S1S1E	34.87	9.66	698.23	90.10
3 x16	2¾x15½	S1S1E	42.62	11.81	853.39	110.11
4x16	3¾x15½	S1S1E	58.12	16.10	1163.71	150.16
6 x16	5½x15½	S4S	85.25	23.61	1706.78	220.23
8 x16	7½x15½	S4S	116.25	32.20	2327.42	300.31
10 x16	9½x15½	S4S	147.25	40.79	2948.07	380.39
12 x16	11½x15½	S4S	178.25	49.37	3568.71	460.48
14 x16	13½x15½	S4S	209.25	57.96	4189.36	540.56
16 x16	15½x15½	S4S	240.25	66.55	4810.00	620.65
2 x18	1¾x17½	S1S1E	30.62	8.48	781.57	89.32
2½x18	2¼x17½	S1S1E	39.37	10.91	1004.88	114.84
3 x18	2¾x17½	S1S1E	48.12	13.33	1228.19	140.36
4 x18	3¾x17½	S1S1E	65.62	18.18	1674.80	191.41
6 x18	5½x17½	S4S	96.25	26.66	2456.38	280.73
8 x18	7½x17½	S4S	131.25	36.36	3349.61	382.81
10 x18	9½x17½	S4S	166.25	46.05	4242.84	484.89
12 x18	11½x17½	S4S	201.25	55.75	5136.07	586.98
14 x18	13½x17½	S4S	236.25	65.44	6029.29	689.06
16 x18	15½x17½	S4S	271.25	75.14	6922.53	791.14
18 x18	17½x17½	S4S	306.25	84.83	7815.76	893.23
20 x20	19½x19½	S4S	380.25	105.33	12049.17	1235.81

PROPERTIES OF YELLOW PINE BEAMS

(Actual size)

8	9	10	11	12	13	14
COEFFICIENT OF STRENGTH.						Coefficient of Deflection Uniform Load Inches
Fibre Stress 1200 Pounds Per Sq. In.	Fibre Stress 1300 Pounds Per Sq. In.	Fibre Stress 1400 Pounds Per Sq. In.	Fibre Stress 1500 Pounds Per Sq. In.	Fibre Stress 1600 Pounds Per Sq. In.	Fibre Stress 1800 Pounds Per Sq. In.	
C12	C13	C14	C15	C16	C18	N
42528	46072	49616	53160	56704	63792	.00003871
54672	59228	63784	68340	72896	82008	.00003011
66824	72393	77961	83530	89099	100236	.00002463
91128	98722	106316	113910	121504	136692	.00001806
133680	144820	155960	167100	178240	200520	.00001232
182248	197435	212623	227810	242997	273372	.00000903
230848	250085	269323	288560	307797	346272	.00000713
279448	302735	326023	349310	372597	419172	.00000589
328048	355385	382723	410060	437397	492072	.00000502
56080	60753	65427	70100	74773	84120	.00002557
72080	78087	84093	90100	96107	108120	.00001989
88088	95429	102769	110110	117451	132132	.00001628
120128	130139	140149	150160	160171	180192	.00001193
176184	190866	205548	220230	234912	264276	.00000814
240248	260269	280289	300310	320331	360372	.00000597
304312	329671	355031	380390	405749	456468	.00000471
368384	399083	429781	460480	491179	552576	.00000389
432448	468485	504523	540560	576597	648672	.00000332
496520	537897	579273	620650	662027	744780	.00000289
71456	77411	83365	89320	95275	107184	.00001777
91872	99528	107184	114840	122496	137808	.00001382
112288	121645	131003	140360	149717	168432	.00001131
153128	165889	178649	191410	204171	229692	.00000829
224584	243299	262015	280730	299445	336876	.00000565
306248	331769	357289	382810	408331	459372	.00000415
387912	420238	452564	484890	517216	581868	.00000327
469584	508716	547848	586980	626112	704376	.00000270
551248	597185	643123	689060	734997	826872	.00000230
632912	685655	738397	791140	843883	949368	.00000201
714584	774133	833681	893230	952779	1071876	.00000178
988648	1071035	1153423	1235810	1318197	1482972	.00000115

PROPERTIES OF YELLOW PINE MILL FLOORS

(Actual thickness)

Made of matched and dressed plank.

1	2	3	4	5	6
Nominal Thickness	Actual Thickness	Area of Section bd. A	Weight Per Square Foot	Moment of Inertia $bd^3/12$ I	Section Modulus $bd^2/6$ S
Inches	Inches	Sq. Ins.	Pounds	Inches^4	Inches^3
2	1 5/8	19.5	5.40	4.29	5.28
2 1/2	2 1/8	25.5	6.90	9.59	9.03
3	2 5/8	31.5	8.70	18.09	13.78
4	3 5/8	43.5	12.00	47.63	26.28
5	4 5/8	55.5	15.40	98.93	42.78
6*	5 5/8	67.5	18.70	177.97	63.28

b = Breadth = 12 inches. d = Thickness.
Heavy Flooring 5 1/2 inches wide over all, 5 1/8 inch face.
*Use for Laminated Floors when made of 2x6 and 4x6 pieces.

PROPERTIES OF YELLOW PINE LAMINATED FLOORS

(Actual thickness)

Made of planks on edge, laid close.

1	2	3	4	5	6
Nominal Thickness	Actual Thickness	Area of Section bd. A	Weight per Square Foot	Moment of Inertia $bd^3/12$ I	Section Modulus $bd^2/6$ S
Inches	Inches	Sq. Ins.	Pounds	Inches^4	Inches^3
6*	5 1/2*	66	18.3	166.37	60.50
8	7 1/2	90	25.0	421.87	112.50
10	9 1/2	114	31.6	857.37	180.50
12	11 1/2	138	38.3	1520.87	264.50

b = Breadth = 12 inches. d = Thickness.
*Use for 2 1/2x6, 3x6, and 6x6 pieces, for 2x6 and 4x6 use Table for Mill Floors.

PROPERTIES OF YELLOW PINE MILL FLOORS

(Actual thickness)
Made of matched and dressed plank.

7	8	9	10	11	12	13
COEFFICIENT OF STRENGTH						Coefficient Of Deflection Uniform Load Inches
Fibre Stress 1200 Pounds per Sq. In.	Fibre Stress 1300 Pounds per Sq. In.	Fibre Stress 1400 Pounds per Sq. In.	Fibre Stress 1500 Pounds per Sq. In.	Fibre Stress 1600 Pounds per Sq. In.	Fibre Stress 1800 Pounds per Sq. In.	
C12	C13	C14	C15	C16	C18	N
4224	4576	4928	5280	5632	6336	.00323750
7224	7826	8428	9030	9632	10836	.00144781
11024	11943	12861	13780	14699	16536	.00076791
21024	22776	24528	26280	28032	31536	.00029157
34224	37076	39928	42780	45632	51336	.00014365
50624	54843	59061	63280	67499	75936	.00007804

b = Breadth = 12 inches. d = Thickness.
Heavy Flooring 5½ inches wide over all, 5⅛ inch face.

PROPERTIES OF YELLOW PINE LAMINATED FLOORS

(Actual thickness)
Made of planks on edge, laid close.

7	8	9	10	11	12	13
COEFFICIENT OF STRENGTH						Coefficient Of Deflection Uniform Load Inches
Fibre Stress 1200 Pounds per Sq. In.	Fibre Stress 1300 Pounds per Sq. In.	Fibre Stress 1400 Pounds per Sq. In.	Fibre Stress 1500 Pounds per Sq. In.	Fibre Stress 1600 Pounds per Sq. In.	Fibre Stress 1800 Pounds per Sq. In.	
C12	C13	C14	C15	C16	C18	N
48400	52433	56467	60500	64533	72600	.00008348
90000	97500	105000	112500	120000	135000	.00003292
144400	156433	168467	180500	192533	216600	.00001657
211600	229233	246867	264500	282133	317400	.00000913

b = Breadth = 12 inches. d = Thickness.

TABLES OF
SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED
FOR YELLOW PINE BEAMS

(Actual size)

The Tables of Safe Loads for Yellow Pine Beams (actual size) give the safe loads in pounds uniformly distributed for all usual spans based upon an extreme fibre stress of 1800 pounds per square inch and the maximum safe load limited by resistance to the horizontal shearing stress along the neutral axis is based on a horizontal shearing stress of 175 pounds per square inch. The tabular loads include the weight of the beam, which must be deducted to obtain the net external load it will safely carry.

The loads indicated "B" are the safe bending loads in pounds uniformly distributed corresponding to the extreme fibre stress of 1800 pounds per square inch.

To convert these loads for other stresses proceed as follows:

Case I. To find the size of timber required for a given uniformly distributed load, span and fibre stress.

f = extreme fibre stress in pounds per square inch.

for f = 1000. Given load $\times 1.8$ = new load.
for f = 1200. Given load $\times 1.5$ = new load.
for f = 1300. Given load $\times 1.4$ = new load.
for f = 1400. Given load $\times 1.3$ = new load.
for f = 1440. Given load $\times 1.25$ = new load.
for f = 1500. Given load $\times 1.2$ = new load.
for f = 1600. Given load $\times 1.13$ = new load.
for f = 1700. Given load $\times 1.06$ = new load.

Find the new load (indicated "B") in tables opposite the span, at head of column will be found the required size of beam.

Case II. To convert the loads indicated "B" for other fibre stresses.

f = extreme fibre stress in pounds per square inch.

for f = 1000. Multiply tabular load by .555
for f = 1200. Multiply tabular load by .667
for f = 1300. Multiply tabular load by .722
for f = 1400. Multiply tabular load by .777
for f = 1440. Multiply tabular load by .800
for f = 1500. Multiply tabular load by .833
for f = 1600. Multiply tabular load by .888
for f = 1700. Multiply tabular load by .944

If a concentrated load is applied at the center of the span, the safe load is one-half the safe uniformly distributed load for the same span; if two equal concentrated loads are applied at the third points of the span, the safe load (the sum of the two loads) is three fourths the safe uniformly distributed load for the same span; two times the safe concentrated load applied at the center of the span is equivalent to the safe uniformly distributed load for the same span; one and one-third times the sum of two equal loads applied at the third points of the span is equivalent to the safe uniformly distributed load for the same span.

The loads indicated "HS" are the safe uniformly distributed loads in pounds which are limited by the resistance to the horizontal shearing stress along the neutral axis of the beam

and are based on a horizontal shearing stress of 175 pounds per square inch. For the safe uniformly distributed loads which are limited by other horizontal shearing stresses see pages 36 and 37. These loads are the MAXIMUM safe uniformly distributed loads that can be applied to the beam for the spans given or for shorter spans.

The loads indicated "D" are the uniformly distributed loads in pounds which produce a deflection of one-thirtieth of an inch per foot of span and are based on a modulus of elasticity of 1,620,000 pounds per square inch.

A concentrated load .625 times the uniformly distributed load and applied at the center of the span will produce the same deflection for the same span; a concentrated load divided into two equal units applied at the third points of the span .734 times the uniformly distributed load will produce the same deflection for the same span.

The deflection in inches indicated "D1" are the deflections produced with a load of 1000 pounds uniformly distributed. The deflection in inches for any uniformly distributed load is obtained by multiplying the deflection indicated "D1" for the proper span by the number of 1000-pound units in the given load. For a concentrated load of 1000 pounds applied at the center of the span the deflection in inches is 1.6 times the deflection for a 1000 pound load uniformly distributed over the same span; for a concentrated load of 1000 pounds divided into two equal units and applied at the third points of the span the deflection is 1.36 times the deflection for a 1000 pound load uniformly distributed over the same span.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

Sufficient bearing should be provided at the ends of the beams so that the allowable intensity of compression across the grain, see page 113, is not exceeded. This effect may be obtained by the use of metal or hardwood corbels or bearing plates arranged to provide a large bearing area against the softer wood.

Fibre stresses should be modified for moving loads, impact or other unusual conditions.

Beams of short length under heavy loads are apparently safe for extreme fibre stress but may fail in horizontal shear. It is therefore necessary to determine by trial which stress should be used and apply this in designing beam.

EXAMPLE

What size beam is required to carry a load of 21,056 pounds uniformly distributed on a span of 6′ 0″?

Assume depth of beam 10″. (Actual 9½″)

$$M = fS = f \times \frac{bd^2}{6} \quad \text{(Page 55)}$$

$$M = \frac{Wl}{8} = f \times \frac{bd^2}{6} \quad \text{(Page 55)}$$

$$\frac{21056 \times 6 \times 12}{8} = \frac{1800 \times b \times 9\frac{1}{2} \times 9\frac{1}{2}}{6}$$

in which b = 7 inches

Therefore a beam 8″ x 10″ (nominal size) will be required if the horizontal shear is not exceeded in formula:

$$W = 4/3 \text{ bds (page 58)}$$
$$21056 = 4/3 \times 7\frac{1}{2} \times 9\frac{1}{2} \times s$$

in which s = 221 pounds per square inch. As the safe horizontal shearing stress is only 175 pounds per square inch, a beam 8″ x 10″ (nominal size) does not have sufficient area to carry a load of 21056 pounds and the breadth of beam must be determined from above formula:

$$W = 4/3 \text{ bds}$$
$$21056 = 4/3 \text{ b } 9\frac{1}{2} \times 175$$
$$\text{in which b} = 9.48 \text{ inches}$$

Therefore a beam 10″ x 10″ (nominal size) will be required.

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the load uniformly distributed that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x4	4x4	4x4	L/30
Actual Size		1⅝x3⅝	3⅝x3⅝	3½x3½	
Span in Feet					
3	HS	1372	3066	2856	
	D1	.0581	.0261	.0299	.100
4	B	1068	2382	2145	
	D	967	2152	1876	.133
	D1	.1379	.0618	.0711	
5	B	854	1905	1716	
	D	619	1382	1201	.166
	D1	.2693	.1206	.1388	
6	B	712	1588	1430	
	D	430	960	834	.200
	D1	.4651	.2083	.2398	
7	B	610	1361	1225	
	D	316	705	613	.233
	D1	.7384	.3307	.3806	
8	B	534	1191	1072	
	D	242	540	469	.266
	D1	1.1020	.4938	.5686	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the load uniformly distributed that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x6	2½x6	3x6	4x6	6x6	L/30
Actual Size		1⅝x5⅝	2¼x5½	2¾x5½	3⅝x5⅝	5½x5½	
Span in Ft.							
4	HS	2135	2887	3528	4760	7056	
	D1	.0369	.0285	.0233	.0165	.0116	.133
5	B	2056	2721	3326	4588	6655	
	D1	.0720	.0557	.0455	.0323	.0227	.166
6	B	1714	2268	2773	3824	5546	
	D	1607	2080	2542	3584	5084	.200
	D1	.1244	.0963	.0787	.0558	.0393	
7	B	1469	1944	2376	3277	4753	
	D	1180	1525	1867	2633	3735	.233
	D1	.1977	.1529	.1250	.0886	.0625	
8	B	1285	1701	2079	2868	4159	
	D	904	1168	1429	2016	2860	.266
	D1	.2950	.2282	.1866	.1323	.0932	
9	B	1143	1512	1848	2549	3697	
	D	714	924	1129	1593	2260	.300
	D1	.4202	.3250	.2657	.1883	.1327	
10	B	1028	1361	1663	2294	3327	
	D	578	745	915	1290	1830	.333
	D1	.5767	.4458	.3643	.2584	.1821	
11	B	935	1237	1512	2086	3025	
	D	478	618	756	1066	1513	.366
	D1	.7671	5933	.4850	.3440	2423	
12	B	857	1134	1386	1912	2773	
	D	402	519	635	896	1271	.400
	D1	.9950	.7703	.6299	.4464	.3147	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x8	2½x8	3x8	4x8	6x8	8x8	L/30
Actual Size		1⅝x7½	2¼x7½	2¾x7½	3¾x7½	5½x7½	7½x7½	
Span in ft.								
6	HS	2843	3937	4812	6562	9625	13125	.200
	D1	.0525	.0379	.0310	.0227	.0155	.0114	
7	B	2611	3617	4419	6027	8839	12053	.233
	D1	.0834	.0602	.0493	.0361	.0246	.0181	
8	B	2284	3165	3867	5274	7734	10547	.266
	D	2142	2966	3625	4944	7251	9888	
	D1	.1245	.0899	.0735	.0539	.0368	.0269	
9	B	2031	2813	3437	4688	6875	9375	.300
	D	1693	2344	2865	3906	5729	7813	
	D1	.1772	.1280	.1047	.0768	.0524	.0384	
10	B	1828	2532	3093	4219	6187	8437	.333
	D	1371	1898	2320	3164	4640	6328	
	D1	.2431	.1756	.1437	.1053	.0718	.0527	
11	B	1661	2302	2812	3835	5625	7670	.366
	D	1133	1569	1918	2615	3835	5230	
	D1	.3235	.2337	.1912	.1402	.0956	.0701	
12	B	1526	2110	2578	3516	5156	7031	.400
	D	952	1318	1612	2197	3223	4394	
	D1	.4202	.3035	.2481	.1821	.1241	.0910	
13	B	1406	1948	2380	3246	4759	6490	.433
	D	811	1123	1373	1873	2746	3744	
	D1	.5343	.3859	.3156	.2313	.1578	.1157	
14	B	1306	1809	2210	3014	4420	6027	.466
	D	700	968	1184	1615	2368	3229	
	D1	.6667	.4821	.3941	.2890	.1971	.1445	
15	B	1218	1688	2065	2813	4125	5625	.500
	D	609	844	1031	1406	2063	2812	
	D1	.8210	.5924	.4850	.3556	.2424	.1778	
16	B	1142	1582	1934	2637	3867	5273	.533
	D	536	742	906	1236	1813	2472	
	D1	.9950	.7188	.5887	.4316	.2942	.2158	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.
The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x10	2½x10	3x10	4x10	6x10	8x10	10x10	L/30
Actual Size		1⅝x9½	2¼x9½	2¾x9½	3¾x9½	5¼x9½	7¼x9½	9¼x9½	
Span in ft.									
8	HS	3601	4987	6097	8312	12190	16625	21056	.266
	D1	.0612	.0442	.0362	.0265	.0181	.0133	.0105	
9	B	3258	4512	5515	7521	11030	15041	19052	.300
	D1	.0872	.0630	.0515	.0378	.0257	.0189	.0149	
10	B	2933	4061	4963	6769	9927	13537	17146	.333
	D	2786	3858	4715	6430	9431	12860	16290	
	D1	.1196	.0864	.0707	.0518	.0353	.0259	.0209	
11	B	2666	3691	4512	6154	9025	12307	15588	.366
	D	2303	3189	3897	5315	7794	10629	13463	
	D1	.1592	.1149	.0941	.0690	.0470	.0345	.0273	
12	B	2444	3384	4136	5641	8273	11281	14289	.400
	D	1935	2679	3275	4466	6549	8931	11313	
	D1	.2067	.1493	.1221	.0896	.0611	.0448	.0353	
13	B	2256	3124	3818	5207	7636	10413	13190	.433
	D	1648	2283	2790	3805	5581	7610	9639	
	D1	.2630	.1898	.1553	.1139	.0776	.0569	.0449	
14	B	2095	2900	3545	4835	7091	9669	12248	.466
	D	1422	1968	2406	3281	4812	6561	8312	
	D1	.3282	.2371	.1939	.1422	.0970	.0711	.0561	
15	B	1955	2707	3309	4513	6618	9025	11431	.500
	D	1238	1715	2096	2858	4192	5716	7240	
	D1	.4040	.2915	.2386	.1750	.1193	.0875	.0691	
16	B	1833	2538	3102	4230	6205	8461	10716	.533
	D	1089	1507	1842	2511	3684	5024	6363	
	D1	.4898	.3539	.2895	.2124	.1447	.1062	.0838	
17	B	1725	2388	2920	3982	5840	7963	10086	.566
	D	964	1335	1632	2225	3263	4450	5637	
	D1	.5878	.4245	.3472	.2547	.1737	.1273	.1005	
18	B	1629	2256	2758	3760	5515	7521	9526	.600
	D	860	1191	1455	1985	2911	3969	5028	
	D1	.6977	.5038	.4124	.3023	.2061	.1512	.1193	
19	B	1544	2137	2612	3563	5225	7125	9025	.633
	D	772	1069	1306	1782	2613	3563	4513	
	D1	.8204	.5925	.4849	.3554	.2424	.1782	.1403	
20	B	1466	2030	2481	3384	4964	6768	8573	.666
	D	697	965	1179	1608	2358	3215	4073	
	D1	.9565	.6908	.5655	.4146	.2827	.2074	.1637	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x12	2½x12	3x12	4x12	L/30
Actual Size		1⅝x11½	2¼x11½	2¾x11½	3¾x11½	
Span in feet						
9	HS	4361	6037	7378	10062	
	D1	.0492	.0355	.0291	.0213	.300
10	B	4298	5951	7273	9919	
	D1	.0674	.0487	.0398	.0292	.333
11	B	3908	5409	6612	9017	
	D1	.0897	.0648	.0530	.0389	.366
12	B	3582	4959	6061	8266	
	D	3432	4752	5808	7921	.400
	D1	.1165	.0842	.0689	.0505	
13	B	3306	4577	5595	7630	
	D	2924	4050	4949	6750	.433
	D1	.1482	.1070	.0875	.0642	
14	B	3070	4250	5195	7085	
	D	2521	3490	4267	5820	.466
	D1	.1851	.1336	.1094	.0802	
15	B	2865	3968	4849	6613	
	D	2196	3042	3717	5070	.500
	D1	.2277	.1644	.1345	.0986	
16	B	2686	3719	4546	6199	
	D	1931	2673	3267	4456	.533
	D1	.2762	.1995	.1632	.1197	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

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"DI" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x12	2½x12	3x12	4x12	L/30
Actual Size		1⅝x11½	2¼x11½	2¾x11½	3¾x11½	
Span in feet						
17	B	2528	3500	4278	5835	
	D	1710	2368	2894	3947	.566
	D1	.3314	.2393	.1958	.1436	
18	B	2388	3306	4041	5510	
	D	1525	2112	2582	3521	.600
	D1	.3934	.2841	.2324	.1704	
19	B	2262	3132	3828	5221	
	D	1369	1896	2317	3160	.633
	D1	.4626	.3340	.2733	.2004	
20	B	2149	2975	3636	4959	
	D	1236	1711	2091	2852	.666
	D1	.5395	.3896	.3188	.2337	
21	B	2047	2834	3463	4724	
	D	1121	1552	1897	2587	.700
	D1	.6244	.4510	.3690	.2706	
22	B	1954	2705	3306	4509	
	D	1021	1414	1728	2357	.733
	D1	.7183	.5186	.4244	.3111	
23	B	1869	2587	3162	4313	
	D	934	1294	1581	2156	.766
	D1	.8208	.5925	.4849	.3556	
24	B	1791	2479	3031	4133	
	D	858	1188	1452	1980	.800
	D1	.9324	.6734	.5510	.4040	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

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The loads given include the weight of the beam.

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"DI" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		6x12	8x12	10x12	12x12	L/30
Actual Size		5½x11½	7½x11½	9½x11½	11½x11½	
Span in feet						
9	HS	14756	20125	25490	30856	.300
	D1	.0145	.0106	.0084	.0069	
10	B	14547	19837	25127	30417	.333
	D1	.0199	.0146	.0115	.0095	
11	B	13225	18034	22842	27652	.366
	D1	.0265	.0194	.0153	.0127	
12	B	12123	16531	20939	25348	.400
	D	11617	15842	20067	24292	
	D1	.0344	.0252	.0199	.0165	
13	B	11190	15259	19328	23398	.433
	D	9899	13499	17098	20698	
	D1	.0438	.0321	.0253	.0209	
14	B	10391	14169	17948	21727	.466
	D	8536	11639	14743	17847	
	D1	.0547	.0401	.0316	.0261	
15	B	9698	13225	16751	20278	.500
	D	7435	10139	12843	15547	
	D1	.0672	.0493	.0389	.0321	
16	B	9092	12398	15705	19011	.533
	D	6535	8911	11288	13664	
	D1	.0816	.0598	.0473	.0390	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size,)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

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"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"DI" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		6x12	8x12	10x12	12x12	L/30
Actual Size		5½x11½	7½x11½	9½x11½	11½x11½	
Span in feet						
17	B	8557	11669	14780	17892	
	D	5789	7894	9999	12104	.566
	D1	.0979	.0718	.0567	.0468	
18	B	8082	11021	13959	16898	
	D	5164	7041	8919	10796	.600
	D1	.1162	.0852	.0673	.0556	
19	B	7656	10441	13224	16009	
	D	4634	6319	8005	9690	.633
	D1	.1367	.1002	.0791	.0654	
20	B	7274	9918	12564	15209	
	D	4182	5703	7224	8745	.666
	D1	.1594	.1169	.0923	.0762	
21	B	6927	9446	11965	14485	
	D	3794	5173	6552	7932	.700
	D1	.1845	.1353	.1068	.0882	
22	B	6612	9017	11421	13826	
	D	3457	4714	5970	7227	.733
	D1	.2121	.1556	.1228	.1015	
23	B	6325	8625	10925	13225	
	D	3163	4313	5463	6612	.766
	D1	.2424	.1778	.1403	.1159	
24	B	6061	8265	10469	12674	
	D	2904	3961	5017	6073	.800
	D1	.2754	.2019	.1594	.1317	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.
The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x14	2½x14	3x14	4x14	6x14	L/30
Actual Size		1¾x13½	2¼x13½	2¾x13½	3¾x13½	5½x13½	
Span in Ft.							
11	HS	5512	7087	8662	11812	17325	.366
	D1	.0515	.0401	.0328	.0240	.0164	
12	B	5316	6834	8353	11391	16710	.400
	D1	.0669	.0520	.0426	.0312	.0213	
13	B	4907	6308	7710	10515	15425	.433
	D1	.0850	.0661	.0541	.0397	.0271	
14	B	4556	5858	7159	9764	14323	.466
	D	4393	5649	6904	9415	13808	
	D1	.1062	.0826	.0676	.0496	.0338	
15	B	4253	5467	6682	9113	13368	.500
	D	3827	4921	6014	8201	12028	
	D1	.1306	.1016	.0831	.0610	.0415	
16	B	3987	5126	6264	8543	12532	.533
	D	3364	4325	5286	7208	10572	
	D1	.1585	.1233	.1009	.0740	.0504	
17	B	3753	4824	5896	8041	11790	.566
	D	2980	3831	4682	6385	9364	
	D1	.1902	.1497	.1210	.0887	.0605	
18	B	3544	4556	5568	7594	11140	.600
	D	2658	3417	4177	5695	8353	
	D1	.2254	.1756	.1437	.1053	.0718	
19	B	3358	4316	5275	7194	10554	.633
	D	2385	3067	3748	5112	7497	
	D1	.2655	.2065	.1689	.1239	.0845	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.
The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L 30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x14	2½x14	3x14	4x14	6x14	L/30
Actual Size		1¾x13½	2¼x13½	2¾x13½	3¾x13½	5¼x13½	
Span in Ft.							
20	B	3190	4100	5012	6834	10026	
	D	2153	2768	3383	4613	6766	.666
	D1	.3097	.2408	.1971	.1445	.0985	
21	B	3038	3905	4773	6509	9549	
	D	1953	2511	3069	4184	6137	.700
	D1	.3585	.2788	.2281	.1673	.1141	
22	B	2900	3728	4556	6213	9114	
	D	1779	2288	2796	3813	5592	.733
	D1	.4122	.3206	.2623	.1923	.1311	
23	B	2774	3566	4358	5943	8718	
	D	1628	2093	2558	3488	5116	.766
	D1	.4710	.3663	.2997	.2198	.1498	
24	B	2658	3417	4176	5695	8355	
	D	1495	1922	2350	3204	4699	.800
	D1	.5351	.4162	.3405	.2497	.1703	
25	B	2552	3280	4009	5468	8021	
	D	1378	1772	2165	2952	4330	.833
	D1	.6048	.4704	.3849	.2822	.1924	
26	B	2454	3154	3855	5257	7712	
	D	1274	1638	2002	2730	4004	.866
	D1	.6804	.5292	.4329	.3175	.2165	
27	B	2363	3037	3712	5063	7427	
	D	1181	1519	1856	2531	3713	.900
	D1	.7619	.5926	.4848	.3555	.2424	
28	B	2278	2929	3579	4882	7161	
	D	1098	1412	1726	2354	3452	.933
	D1	.8498	.6609	.5407	.3965	.2704	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		8x14	10x14	12x14	14x14	L/30
Actual Size		7½x13½	9½x13½	11½x13½	13½x13½	
Span in Feet						
11	HS	23625	29925	36225	42525	.366
	D1	.0120	.0095	.0078	.0067	
12	B	22781	28856	34931	41006	.400
	D1	.0156	.0123	.0102	.0087	
13	B	21028	26636	32244	37852	.433
	D1	.0198	.0156	.0129	.0110	
14	B	19526	24734	29941	35148	.466
	D	18829	23850	28871	33893	
	D1	.0248	.0196	.0162	.0137	
15	B	18225	23085	27945	32805	.500
	D	16401	20776	25150	29524	
	D1	.0305	.0241	.0198	.0169	
16	B	17086	21642	26198	30754	.533
	D	14416	18260	22105	25949	
	D1	.0370	.0292	.0241	.0205	
17	B	16081	20369	24657	28945	.566
	D	12770	16175	19580	22986	
	D1	.0444	.0350	.0289	.0246	
18	B	15187	19237	23287	27337	.600
	D	11391	14428	17465	20503	
	D1	.0527	.0416	.0343	.0292	
19	B	14388	18225	22062	25898	.633
	D	10223	12949	15675	18402	
	D1	.0619	.0489	.0404	.0344	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L 30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		8x14	10x14	12x14	14x14	L/30
Actual Size		7½x13½	9½x13½	11½x13½	13½x13½	
Span in Feet						
20	B	13688	17313	20958	24604	.666
	D	9227	11686	14147	16608	
	D1	.0723	.0570	.0471	.0401	
21	B	13018	16489	19960	23432	.700
	D	8369	10600	12831	15063	
	D1	.0836	.0660	.0545	.0465	
22	B	12426	15740	19053	22367	.733
	D	7625	9659	11692	13725	
	D1	.0962	.0759	.0627	.0534	
23	B	11886	15055	18225	21394	.766
	D	6977	8837	10697	12557	
	D1	.1099	.0867	.0717	.0610	
24	B	11390	14428	17465	20503	.800
	D	6407	8116	9825	11533	
	D1	.1249	.0986	.0814	.0694	
25	B	10935	13851	16767	19683	.833
	D	5905	7480	9054	10629	
	D1	.1411	.1114	.0920	.0784	
26	B	10514	13318	16122	18926	.866
	D	5460	6915	8371	9827	
	D1	.1588	.1253	.1035	.0882	
27	B	10125	12825	15525	18225	.900
	D	5062	6412	7763	9112	
	D1	.1778	.1403	.1159	.0987	
28	B	9763	12367	14970	17574	.933
	D	4707	5963	7218	8474	
	D1	.1983	.1565	.1293	.1101	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x16	2½x16	3x16	4x16	6x16	L/30
Actual Size		1¾x15½	2¼x15½	2¾x15½	3¾x15½	5¼x15½	
Span in Ft.							
13	HS	6328	8137	9947	13562	19890	.433
	D1	.0562	.0437	.0357	.0262	.0178	
14	B	6008	7723	9438	12870	18877	.466
	D1	.0702	.0546	.0446	.0327	.0223	
15	B	5608	7208	8809	12013	17618	.500
	D1	.0863	.0671	.0549	.0403	.0274	
16	B	5257	6757	8258	11262	16517	.533
	D	5091	6546	8001	10909	16001	
	D1	.1047	.0815	.0666	.0489	.0333	
17	B	4948	6360	7772	10599	15546	.566
	D	4510	5798	7087	9664	14174	
	D1	.1256	.0977	.0799	.0586	.0399	
18	B	4673	6006	7341	10010	14682	.600
	D	4023	5172	6322	8620	12643	
	D1	.1492	.1160	.0949	.0696	.0474	
19	B	4427	5690	6954	9484	13909	.633
	D	3610	4642	5673	7737	11347	
	D1	.1754	.1364	.1116	.0818	.0558	
20	B	4206	5406	6606	9009	13214	.666
	D	3258	4189	5120	6982	10241	
	D1	.2046	.1591	.1302	.0955	.0651	
21	B	4006	5148	6292	8580	12585	.700
	D	2956	3800	4644	6333	9289	
	D1	.2368	.1842	.1507	.1105	.0753	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/36" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x16	2½x16	3x16	4x16	6x16	L/30
Actual Size		1¾x15½	2¼x15½	2¾x15½	3¾x15½	5¼x15½	
Span in Ft.							
22	B	3824	4914	6006	8190	12012	.733
	D	2693	3462	4232	5770	8463	
	D1	.2723	.2118	.1733	.1271	.0866	
23	B	3657	4701	5745	7834	11490	.766
	D	2464	3168	3872	5280	7743	
	D1	.3112	.2420	.1980	.1452	.0990	
24	B	3505	4505	5505	7508	11012	.800
	D	2263	2909	3556	4849	7112	
	D1	.3535	.2750	.2250	.1650	.1125	
25	B	3365	4325	5285	7208	10571	.833
	D	2085	2681	3277	4469	6554	
	D1	.3996	.3108	.2543	.1865	.1271	
26	B	3235	4159	5082	6930	10164	.866
	D	1928	2479	3030	4132	6060	
	D1	.4495	.3496	.2860	.2099	.1430	
27	B	3116	4004	4894	6674	9788	.900
	D	1788	2299	2810	3831	5619	
	D1	.5034	.3915	.3203	.2349	.1602	
28	B	3004	3861	4719	6435	9438	.933
	D	1663	2137	2612	3562	5225	
	D1	.5614	.4367	.3573	.2620	.1786	
29	B	2901	3728	4556	6214	9113	.966
	D	1550	1993	2436	3321	4871	
	D1	.6238	.4851	.3969	.2911	.1984	
30	B	2804	3604	4404	6006	8809	1.000
	D	1448	1862	2276	3103	4551	
	D1	.6905	.5371	.4394	.3222	.2197	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual Size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		8x16	10x16	12x16	14x16	16x16	L/30
Actual Size		7½x15½	9½x15½	11½x15½	13½x15½	15½x15½	
Span in Ft.							
13	HS	27125	34359	41590	48825	56056	.433
	D1	.0131	.0103	.0085	.0073	.0063	
14	B	25741	32605	39469	46334	53199	.466
	D1	.0164	.0129	.0107	.0091	.0079	
15	B	24025	30431	36838	43245	49652	.500
	D1	.0201	.0159	.0131	.0112	.0097	
16	B	22524	28529	34536	40542	46549	.533
	D	21820	27638	33457	39275	45094	
	D1	.0244	.0193	.0159	.0136	.0118	
17	B	21198	26851	32504	38157	43811	.566
	D	19328	24482	29636	34791	39945	
	D1	.0293	.0231	.0191	.0163	.0142	
18	B	20021	25359	30698	36037	41377	.600
	D	17240	21837	26435	31032	35630	
	D1	.0348	.0275	.0227	.0193	.0168	
19	B	18967	24025	29083	34141	39199	.633
	D	15473	19599	23725	27852	31978	
	D1	.0409	.0323	.0267	.0227	.0198	
20	B	18019	22824	27629	32434	37239	.666
	D	13965	17688	21412	25136	28860	
	D1	.0477	.0377	.0311	.0265	.0231	
21	B	17161	21736	26313	30889	35466	.700
	D	12666	16044	19422	22799	26177	
	D1	.0553	.0436	.0360	.0307	.0267	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		8x16	10x16	12x16	14x16	16x16	L/30
Actual Size		7½x15½	9½x15½	11½x15½	13½x15½	15½x15½	
Span in Ft.							
22	B	16381	20749	25117	29485	33854	
	D	11541	14618	17696	20774	23851	.733
	D1	.0635	.0502	.0414	.0353	.0307	
23	B	15668	19846	24025	28203	32382	
	D	10559	13375	16191	19006	21822	.766
	D1	.0726	.0573	.0473	.0403	.0351	
24	B	15015	19019	23024	27028	31033	
	D	9698	12283	14869	17456	19138	.800
	D1	.0825	.0651	.0538	.0458	.0418	
25	B	14415	18259	22103	25947	29791	
	D	8938	11320	13704	16087	18470	.833
	D1	.0932	.0736	.0608	.0518	.0451	
26	B	13861	17556	21235	24949	28645	
	D	8263	10466	12670	14873	17077	.866
	D1	.1049	.0828	.0684	.0583	.0507	
27	B	13347	16906	20466	24025	27584	
	D	7662	9706	11749	13792	15836	.900
	D1	.1174	.0927	.0766	.0652	.0568	
28	B	12870	16302	19735	23167	26599	
	D	7125	9025	10924	12825	14724	.933
	D1	.1310	.1034	.0854	.0728	.0634	
29	B	12427	15740	19054	22368	25682	
	D	6642	8413	10184	11952	13726	.966
	D1	.1455	.1149	.0949	.0809	.0704	
30	B	12012	15216	18419	21622	24826	
	D	6206	7862	9517	11172	12827	1.000
	D1	.1611	.1272	.1051	.0895	.0779	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.
The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x18	2½x18	3x18	4x18	6x18	8x18	L/30
Actual Size		1¾x17½	2¼x17½	2¾x17½	3¾x17½	5¼x17½	7½x17½	
Span in Ft.								
15	HS	7147	9187	11223	15312	22459	30625	.500
	D1	.0599	.0466	.0382	.0279	.0191	.0143	
16	B	6699	8613	10527	14356	21055	28711	.533
	D1	.0728	.0566	.0463	.0339	.0231	.0169	
17	B	6305	8106	9908	13511	19816	27022	.566
	D1	.0873	.0679	.0555	.0407	.0278	.0204	
18	B	5954	7656	9356	12760	18715	25521	.600
	D	5790	7444	9098	12406	18195	24812	
	D1	.1036	.0806	.0659	.0483	.0329	.0242	
19	B	5641	7253	8865	12089	17730	24177	.633
	D	5196	6681	8165	11134	16330	22269	
	D1	.1219	.0948	.0775	.0569	.0388	.0284	
20	B	5359	6890	8421	11484	16844	22968	.666
	D	4690	6029	7369	10049	14738	20098	
	D1	.1422	.1106	.0904	.0663	.0452	.0332	
21	B	5104	6562	8020	10938	16042	21875	.700
	D	4254	5469	6684	9115	13368	18229	
	D1	.1646	.1280	.1047	.0768	.0523	.0384	
22	B	4872	6264	7656	10440	15312	20880	.733
	D	3876	4983	6090	8305	12180	16609	
	D1	.1892	.1472	.1204	.0883	.0602	.0441	
23	B	4660	5991	7323	9986	14647	19973	.766
	D	3546	4559	5572	7598	11144	15197	
	D1	.2162	.1682	.1376	.1009	.0688	.0504	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.

The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		2x18	2½x18	3x18	4x18	6x18	8x18	L/30
Actual Size		1¾x17½	2¼x17½	2¾x17½	3¾x17½	5½x17½	7½x17½	
Span in Ft.								
24	B	4466	5742	7018	9570	14036	19140	
	D	3257	4187	5118	6978	10235	13956	.800
	D1	.2456	.1911	.1563	.1146	.0782	.0573	
25	B	4287	5512	6737	9188	13475	18375	
	D	3001	3859	4716	6431	9433	12862	.833
	D1	.2777	.2159	.1767	.1296	.0883	.0648	
26	B	4122	5300	6478	8834	12957	17668	
	D	2775	3568	4361	5946	8721	11892	.866
	D1	.3123	.2429	.1987	.1457	.0994	.0729	
27	B	3970	5104	6238	8507	12477	17014	
	D	2573	3308	4043	5514	8087	11027	.900
	D1	.3498	.2720	.2226	.1632	.1113	.0816	
28	B	3828	4922	6015	8203	12031	16406	
	D	2392	3076	3760	5127	7520	10254	.933
	D1	.3902	.3034	.2482	.1820	.1241	.0910	
29	B	3696	4752	5808	7920	11616	15841	
	D	2230	2868	3505	4780	7010	9559	.966
	D1	.4334	.3371	.2758	.2022	.1379	.1011	
30	B	3573	4594	5614	7656	11229	15312	
	D	2085	2680	3275	4466	6550	8932	1.000
	D1	.4798	.3732	.3053	.2239	.1526	.1119	
31	B	3457	4445	5433	7409	10867	14818	
	D	1952	2510	3067	4183	6134	8365	1.033
	D1	.5294	.4117	.3369	.2470	.1684	.1235	
32	B	3349	4306	5263	7178	10527	14355	
	D	1832	2355	2879	3925	5757	7851	1.066
	D1	.5823	.4529	.3708	.2717	.1853	.1358	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.
The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		10x18	12x18	14x18	16x18	18x18	L/30
Actual Size		9½x17½	11½x17½	13½x17½	15½x17½	17½x17½	
Span in Ft.							
15	HS	38790	46959	55125	63290	71456	.500
	D1	.0110	.0091	.0077	.0067	.0059	
16	B	36367	44024	51679	59336	66992	.533
	D1	.0134	.0111	.0094	.0082	.0073	
17	B	34227	41434	48639	55845	63051	.566
	D1	.0161	.0133	.0113	.0094	.0087	
18	B	32326	39132	45938	52743	59549	.600
	D	31428	38045	44661	51278	58290	
	D1	.0191	.0157	.0134	.0117	.0103	
19	B	30624	37072	43520	49966	56414	.633
	D	28207	34145	40084	46022	51961	
	D1	.0224	.0185	.0158	.0137	.0122	
20	B	29094	35219	41344	47469	53594	.666
	D	25457	30816	36175	41535	46894	
	D1	.0262	.0216	.0184	.0160	.0142	
21	B	27708	33542	39375	45208	51042	.700
	D	23090	27951	32812	37673	42534	
	D1	.0303	.0250	.0213	.0186	.0164	
22	B	26449	32017	37585	43153	48721	.733
	D	21039	25468	29897	34327	38756	
	D1	.0348	.0288	.0245	.0213	.0189	
23	B	25299	30625	35951	41277	46603	.766
	D	19249	23301	27354	31407	35459	
	D1	.0398	.0329	.0280	.0244	.0216	

SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS

(Actual size)

Beams supported at both ends.
The loads given include the weight of the beam.

Fibre stress 1800 pounds per square inch, horizontal shearing stress 175 pounds per square inch, modulus of elasticity 1,620,000 pounds per square inch.

"HS" indicates the MAXIMUM SAFE LOAD uniformly distributed that can be applied to the beam and corresponds to the horizontal shearing stress along the neutral axis.

"B" indicates the safe bending load uniformly distributed and corresponds to the extreme fibre stress.

"D" indicates the uniformly distributed load that produces a deflection of one-thirtieth of an inch per foot of span.

"D1" indicates the deflection in inches with a load of 1000 pounds uniformly distributed.

"L/30" indicates the deflection in inches which is one-thirtieth of an inch per foot of span.

TO USE FOR OTHER STRESSES AND LOADINGS, SEE PAGE 12.

Nominal Size		10x18	12x18	14x18	16x18	18x18	L/30
Actual Size		9½x17½	11½x17½	13½x17½	15½x17½	17½x17½	
Span in Ft.							
24	B	24245	29349	34453	39557	44661	
	D	17678	21400	25122	28844	32566	.800
	D1	.0452	.0374	.0318	.0277	.0245	
25	B	23275	28175	33075	37975	42875	
	D	16292	19722	23152	26528	30012	.833
	D1	.0511	.0422	.0360	.0313	.0277	
26	B	22379	27091	31803	36514	41226	
	D	15063	18234	21406	24577	27749	.866
	D1	.0575	.0475	.0405	.0353	.0312	
27	B	21551	26088	30625	35162	39699	
	D	13968	16909	19849	22790	25731	.900
	D1	.0644	.0532	.0453	.0395	.0350	
28	B	20781	25156	29531	33906	38281	
	D	12988	15723	18457	21191	23925	.933
	D1	.0718	.0594	.0506	.0440	.0390	
29	B	20064	24289	28513	32737	36961	
	D	12108	14657	17206	19755	22304	.966
	D1	.0798	.0659	.0562	.0489	.0433	
30	B	19396	23479	27562	31646	35729	
	D	11314	13696	16078	18460	20842	1.000
	D1	.0884	.0730	.0622	.0542	.0480	
31	B	18770	22722	26673	30625	34577	
	D	10596	12827	15057	17288	19519	1.033
	D1	.0975	.0805	.0686	.0598	.0529	
32	B	18184	22012	25840	29668	33496	
	D	9944	12038	14131	16224	18318	1.066
	D1	.1072	.0886	.0755	.0657	.0582	

TABLE OF SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS LIMITED BY RESISTANCE TO HORIZONTAL SHEAR ALONG THE NEUTRAL AXIS.

(Actual size)

Nominal Size	Actual Size	Horizontal Shearing Stress in Pounds per Square Inch.				
		100#	125#	150#	175#	200#
2 x 4	1⅝x 3⅝	784	980	1176	1372	1568
4 x 4	3⅝x 3⅝	1752	2190	2628	3066	3504
4 x 4	3½x 3½	1632	2040	2448	2856	3264
2 x 6	1⅝x 5⅝	1220	1525	1830	2135	2440
2½x 6	2¼x 5½	1650	2062	2475	2887	3300
3 x 6	2¾x 5½	2016	2520	3024	3528	4032
4 x 6	3⅝x 5⅝	2720	3400	4080	4760	5440
6 x 6	5½x 5½	4032	5040	6048	7056	8064
2 x 8	1⅝x 7½	1625	2031	2437	2843	3249
2½x 8	2¼x 7½	2250	2812	3375	3937	4500
3 x 8	2¾x 7½	2750	3437	4125	4812	5500
4 x 8	3¾x 7½	3750	4687	5625	6562	7500
6 x 8	5½x 7½	5500	6875	8250	9625	11000
8 x 8	7½x 7½	7500	9375	11250	13125	15000
2 x10	1⅝x 9½	2058	2572	3087	3601	4116
2½x10	2¼x 9½	2850	3562	4275	4987	5700
3 x10	2¾x 9½	3484	4355	5226	6097	6968
4 x10	3¾x 9½	4750	5937	7125	8312	9500
6 x10	5½x 9½	6966	8707	10449	12190	13932
8 x10	7½x 9½	9500	11875	14250	16625	19000
10 x10	9½x 9½	12032	15040	18048	21056	24064
2 x12	1⅝x11½	2492	3115	3738	4361	4984
2½x12	2¼x11½	3450	4312	5175	6037	6900
3 x12	2¾x11½	4216	5270	6324	7378	8432
4 x12	3¾x11½	5750	7187	8625	10062	11500
6 x12	5½x11½	8432	10540	12648	14756	16864
8 x12	7½x11½	11500	14375	17250	20125	23000
10 x12	9½x11½	14566	18207	21849	25490	29132
12 x12	11½x11½	17632	22040	26448	30856	35264

TABLE OF SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR YELLOW PINE BEAMS LIMITED BY RESISTANCE TO HORIZONTAL SHEAR ALONG THE NEUTRAL AXIS.

(Actual size)

Nominal Size	Actual Size	Horizontal Shearing Stress in Pounds per Square Inch				
		100#	125#	150#	175#	200#
2 x14	1¾x13½	3150	3937	4725	5512	6300
2½x14	2¼x13½	4050	5062	6075	7087	8100
3 x14	2¾x13½	4950	6187	7425	8662	9900
4 x14	3¾x13½	6750	8437	10125	11812	13500
6 x14	5½x13½	9900	12375	14875	17325	19800
8 x14	7½x13½	13500	16875	20250	23625	27000
10 x14	9½x13½	17100	21375	25650	29925	34200
12 x14	11½x13½	20700	25875	31050	36225	41400
14 x14	13½x13½	24300	30375	36450	42525	48600
2 x16	1¾x15½	3616	4520	5424	6328	7232
2½x16	2¼x15½	4650	5812	6975	8137	9300
3 x16	2¾x15½	5684	7105	8526	9947	11368
4 x16	3¾x15½	7750	9687	11625	13562	15500
6 x16	5½x15½	11366	14207	17049	19890	22732
8 x16	7½x15½	15500	19375	23250	27125	31000
10 x16	9½x15½	19634	24542	29451	34359	39268
12 x16	11½x15½	23766	29707	35649	41590	47532
14 x16	13½x15½	27900	34875	41850	48825	55800
16 x16	15½x15½	32032	40040	48048	56056	64064
2 x18	1¾x17½	4084	5105	6126	7147	8168
2½x18	2¼x17½	5250	6562	7875	9187	10500
3 x18	2¾x17½	6416	8020	9624	11228	12832
4 x18	3¾x17½	8750	10937	13125	15312	17500
6 x18	5½x17½	12834	16042	19251	22459	25668
8 x18	7½x17½	17500	21875	26250	30625	35000
10 x18	9½x17½	22166	27707	33249	38790	44332
12 x18	11½x17½	26834	33542	40251	46959	53668
14 x18	13½x17½	31500	39375	47250	55125	63000
16 x18	15½x17½	36166	45207	54249	63290	72332
18 x18	17½x17½	40832	51040	61248	71456	81664
20 x20	19½x19½	50700	63375	76050	88725	101400

MAXIMUM MOMENTS OF RESISTANCE IN FOOT POUNDS FOR YELLOW PINE BEAMS

(Actual size)

EXAMPLE

Find maximum bending moment for a beam 12"x12" with a fibre stress of 1800 lbs. per sq. in.

From page **55** $M = fS = f \times \frac{bd^2}{6}$

$$M = \frac{1800 \times 11.5 \times (11.5)^2}{12 \times 6} = 38022 \text{ ft. lbs.}$$

Bending moment diagrams are shown on page 59.

Nominal Size	Actual Size	MAXIMUM MOMENT OF RESISTANCE IN FOOT LBS. Fibre Stress 1200# Per Sq. In.	Fibre Stress 1300# Per Sq. In.	Fibre Stress 1500# Per Sq. In.	Fibre Stress 1800# Per Sq. In.
2 x 4	1 5/8 x 3 5/8	356	385	444	534
4 x 4	3 5/8 x 3 5/8	794	860	992	1190
4 x 4	3 1/2 x 3 1/2	715	774	893	1072
2 x 6	1 5/8 x 5 5/8	857	928	1071	1285
2 1/2 x 6	2 1/4 x 5 1/2	1134	1228	1417	1701
3 x 6	2 3/4 x 5 1/2	1386	1501	1732	2079
4 x 6	3 5/8 x 5 5/8	1912	2071	2390	2868
6 x 6	5 1/2 x 5 1/2	2773	3004	3466	4159
2 x 8	1 5/8 x 7 1/2	1523	1650	1904	2284
2 1/2 x 8	2 1/4 x 7 1/2	2110	2285	2637	3165
3 x 8	2 3/4 x 7 1/2	2578	2793	3222	3867
4 x 8	3 3/4 x 7 1/2	3516	3809	4395	5274
6 x 8	5 1/2 x 7 1/2	5156	5585	6445	7734
8 x 8	7 1/2 x 7 1/2	7031	7616	8787	10545
2 x10	1 5/8 x 9 1/2	2444	2648	3055	3666
2 1/2 x10	2 1/4 x 9 1/2	3384	3666	4230	5076
3 x10	2 3/4 x 9 1/2	4136	4480	5170	6204
4 x10	3 3/4 x 9 1/2	5641	6110	7050	8461
6 x10	5 1/2 x 9 1/2	8273	8962	10341	12409
8 x10	7 1/2 x 9 1/2	11281	12221	14100	16921
10 x10	9 1/2 x 9 1/2	14289	15480	17862	21435
2 x12	1 5/8 x11 1/2	3582	3880	4477	5373
2 1/2 x12	2 1/4 x11 1/2	4958	5371	6197	7436
3 x12	2 3/4 x11 1/2	6060	6565	7575	9090
4 x12	3 3/4 x11 1/2	8266	8955	10332	12399
6 x12	5 1/2 x11 1/2	12123	13133	15153	18185
8 x12	7 1/2 x11 1/2	16531	17908	20664	24796
10 x12	9 1/2 x11 1/2	20939	22683	26174	31408
12 x12	11 1/2 x11 1/2	25348	27460	31684	38022

MAXIMUM MOMENTS OF RESISTANCE IN FOOT POUNDS FOR YELLOW PINE BEAMS

(Actual size)

Bending moment diagrams are shown on page 59.

Nominal Size	Actual Size	MAXIMUM MOMENT OF RESISTANCE IN FOOT LBS. Fibre Stress 1200# Per Sq. In.	Fibre Stress 1300# Per Sq. In.	Fibre Stress 1500# Per Sq. In.	Fibre Stress 1800# Per Sq. In.
2 x14	1¾x13½	5316	5759	6645	7974
2½ x14	2¼x13½	6834	7403	8542	10251
3 x14	2¾x13½	8353	9049	10441	12529
4 x14	3¾x13½	11391	12340	14238	17086
6 x14	5½x13½	16710	18102	20887	25065
8 x14	7½x13½	22781	24679	28476	34174
10 x14	9½x13½	28856	31261	36071	43284
12 x14	11½x13½	34931	37841	43664	52396
14 x14	13½x13½	41006	44423	51257	61508
2 x16	1¾x15½	7010	7594	8762	10515
2½ x16	2¼x15½	9010	9760	11262	13515
3 x16	2¾x15½	11011	11928	13763	16516
4 x16	3¾x15½	15016	16267	18770	22524
6 x16	5½x15½	22023	23858	27528	33033
8 x16	7½x15½	30031	32533	37538	45046
10 x16	9½x15½	38039	41208	47548	57058
12 x16	11½x15½	46048	49885	57560	69072
14 x16	13½x15½	54056	58560	67569	81084
16 x16	15½x15½	62065	67237	77581	93097
2 x18	1¾x17½	8932	9676	11165	13398
2½ x18	2¼x17½	11484	12441	14355	17226
3 x18	2¾x17½	14036	15205	17545	21054
4 x18	3¾x17½	19141	20736	23926	28711
6 x18	5½x17½	28073	30412	35091	42109
8 x18	7½x17½	38281	41471	47850	57421
10 x18	9½x17½	48489	52530	60612	72734
12 x18	11½x17½	58698	63590	73373	88047
14 x18	13½x17½	68906	74648	86133	103359
16 x18	15½x17½	79114	85706	98892	118671
18 x18	17½x17½	89322	96765	111652	133982
20 x20	19½x19½	123580	133878	154475	185370

MAXIMUM SPANS
FOR YELLOW PINE MILL FLOORS

(Actual thickness)

Made of matched and dressed plank.

Fibre stress 1200, 1300, 1500, 1600 and 1800 pounds per square inch; modulus of elasticity 1,620,000 pounds per square inch.

The SUM of the live load and the weight of the floor (see table of properties) was used in calculating the spans.

In the line marked DEFLECTION is given the span which has a deflection of one-thirtieth of an inch per foot of span.

Nominal Thickness	Actual Thickness	Fibre Stress Pounds Per Sq. In	SPAN IN FEET — LIVE LOAD IN POUNDS PER SQUARE FOOT					
			50#	100#	125#	150#	175#	200#
2"	1⅝"	1200	8′ 9″	6′ 4″	5′ 8″	5′ 3″	4′10″	4′ 6″
"	"	1300	9′ 1″	6′ 7″	5′11″	5′ 5″	5′ 0″	4′ 9″
"	"	1500	9′ 9″	7′ 1″	6′ 4″	5′10″	5′ 5″	5′ 1″
"	"	1600	10′ 1″	7′ 4″	6′ 7″	6′ 0″	5′ 7″	5′ 3″
"	"	1800	10′ 8″	7′ 9″	7′ 0″	6′ 5″	5′11″	5′ 7″
"	"	Deflection	5′8½″	4′ 7″	4′ 3″	4′ 0″	3′10″	3′ 8″
2½"	2⅛"	1200	11′ 3″	8′ 2″	7′ 5″	6′ 9″	6′ 4″	5′11″
"	"	1300	11′ 9″	8′ 7″	7′ 9″	7′ 1″	6′ 7″	6′ 2″
"	"	1500	12′ 7″	9′ 2″	8′ 3″	7′ 7″	7′ 0″	6′ 7″
"	"	1600	13′ 0″	9′ 6″	8′ 6″	7′10″	7′ 3″	6′10″
"	"	1800	13′10″	10′ 1″	9′ 1″	8′ 4″	7′ 8″	7′ 3″
"	"	Deflection	7′ 5″	6′ 0″	5′ 7″	5′ 3″	5′ 0″	4′10″
3"	2⅝"	1200	13′ 8″	10′ 1″	9′ 1″	8′ 4″	7′ 9″	7′ 3″
"	"	1300	14′ 3″	10′ 6″	9′ 6″	8′ 8″	8′ 1″	7′ 7″
"	"	1500	15′ 4″	11′ 3″	10′ 2″	9′ 4″	8′ 8″	8′ 2″
"	"	1600	15′10″	11′ 8″	10′ 6″	9′ 7″	8′11″	8′ 4″
"	"	1800	16′ 9″	12′ 4″	11′ 2″	10′ 3″	9′ 6″	8′11″
"	"	Deflection	9′ 0″	7′ 4″	6′11″	6′ 6″	6′ 2″	5′11″
4"	3⅝"	1200	18′ 5″	13′ 8″	12′ 4″	11′ 5″	10′ 7″	10′ 0″
"	"	1300	19′ 2″	14′ 3″	12′11″	11′10″	11′ 0″	10′ 4″
"	"	1500	20′ 7″	15′ 4″	13′10″	12′ 9″	11′10″	11′ 2″
"	"	1600	21′ 3″	15′10″	14′ 4″	13′ 2″	12′ 3″	11′ 6″
"	"	1800	22′ 7″	16′ 9″	15′ 2″	13′11″	13′ 0″	12′ 2″
"	"	Deflection	12′ 3″	10′ 1″	9′ 5″	8′11″	8′ 6″	8′ 2″
5"	4⅝"	1200	22′10″	17′ 8″	15′ 7″	14′ 5″	13′ 5″	12′ 7″
"	"	1300	23′10″	17′11″	16′ 3″	14′11″	13′11″	13′ 1″
"	"	1500	25′ 7″	19′ 3″	17′ 5″	16′ 1″	15′ 0″	14′ 1″
"	"	1600	26′ 5″	19′11″	18′ 0″	16′ 7″	15′ 6″	14′ 7″
"	"	1800	28′ 0″	21′ 1″	19′ 1″	17′ 7″	16′ 5″	15′ 5″
"	"	Deflection	15′ 4″	12′ 9″	11′11″	11′ 3″	10′ 9″	10′ 4″
6"*	5⅝"*	1200	.....	20′ 8″	18′ 9″	17′ 4″	16′ 2″	15′ 3″
"	"	1300	.....	21′ 6″	19′ 6″	18′ 0″	16′10″	15′10″
"	"	1500	.....	23′ 1″	21′ 0″	19′ 4″	18′ 1″	17′ 0″
"	"	1600	.....	23′10″	21′ 8″	20′ 0″	18′ 8″	17′ 7″
"	"	1800	.....	25′ 3″	23′ 0″	21′ 2″	19′10″	18′ 8″
"	"	Deflection	.....	15′ 4″	14′ 5″	13′ 8″	13′ 0″	12′ 6″

*Use for Laminated Floors when made of 2x6 and 4x6 pieces.

MAXIMUM SPANS

FOR YELLOW PINE MILL FLOORS

(Actual thickness)

Made of matched and dressed plank.

Fibre stress 1200, 1300, 1500, 1600 and 1800 pounds per square inch; modulus of elasticity 1,620,000 pounds per square inch.

The SUM of the live load and the weight of the floor (see table of properties) was used in calculating the spans.

In the line marked DEFLECTION is given the span which has a deflection of one-thirtieth of an inch per foot of span.

Nominal Thickness	Actual Thickness	Fibre Stress Pounds Per Sq. In.	SPAN IN FEET — LIVE LOAD IN POUNDS PER SQUARE FOOT					
			225#	250#	275#	300#	350#	400#
2"	1⅝"	1200						
"	"	1300						
"	"	1500						
"	"	1600						
"	"	1800						
"	"	Deflection						
2½"	2⅛"	1200	5′ 7″	5′ 4″				
"	"	1300	5′10″	5′ 6″				
"	"	1500	6′ 3″	5′11″				
"	"	1600	6′ 6″	6′ 1″				
"	"	1800	6′10″	6′ 6″				
"	"	Deflection	4′ 8″	4′ 6″				
3"	2⅝"	1200	6′10″	6′ 6″	6′ 3″	6′ 0″	5′ 7″	5′ 2″
"	"	1300	7′ 2″	6′10″	6′ 6″	6′ 3″	5′ 9″	5′ 5″
"	"	1500	7′ 8″	7′ 4″	7′ 0″	6′ 8″	6′ 2″	5′10″
"	"	1600	7′11″	7′ 7″	7′ 2″	6′11″	6′ 5″	6′ 0″
"	"	1800	8′ 5″	8′ 0″	7′ 8″	7′ 4″	6′ 9″	6′ 4″
"	"	Deflection	5′ 8″	5′ 6″	5′ 4″	5′ 2″	4′11″	4′ 9″
4"	3⅝"	1200	9′ 5″	9′ 0″	8′ 7″	8′ 3″	7′ 7″	7′ 2″
"	"	1300	9′10″	9′ 4″	8′11″	8′ 7″	7′11″	7′ 5″
"	"	1500	10′ 6″	10′ 0″	9′ 7″	9′ 2″	8′ 6″	8′ 0″
"	"	1600	10′11″	10′ 4″	9′11″	9′ 6″	8′10″	8′ 3″
"	"	1800	11′ 7″	11′ 0″	10′ 6″	10′ 1″	9′ 4″	8′ 9″
"	"	Deflection	7′10″	7′ 7″	7′ 4″	7′ 2″	6′10″	6′ 6″
5"	4⅝"	1200	11′11″	11′ 4″	10′10″	10′ 5″	9′ 8″	9′ 1″
"	"	1300	12′ 5″	11′10″	11′ 4″	10′10″	10′ 1″	9′ 5″
"	"	1500	13′ 4″	12′ 8″	12′ 2″	11′ 8″	10′10″	10′ 2″
"	"	1600	13′ 9″	13′ 1″	12′ 6″	12′ 0″	11′ 2″	10′ 6″
"	"	1800	14′ 7″	13′11″	13′ 4″	12′ 9″	11′10″	11′ 1″
"	"	Deflection	10′ 0″	9′ 8″	9′ 4″	9′ 1″	8′ 8″	8′ 4″
6"*	5⅝"*	1200	14′ 5″	13′ 9″	13′ 2″	12′ 8″	11′ 9″	11′ 0″
"	"	1300	15′ 0″	14′ 3″	13′ 8″	13′ 1″	12′ 2″	11′ 5″
"	"	1500	16′ 1″	15′ 4″	14′ 8″	14′ 1″	13′ 1″	12′ 3″
"	"	1600	16′ 7″	15′10″	15′ 2″	14′ 7″	13′ 6″	12′ 8″
"	"	1800	17′ 8″	16′10″	16′ 1″	15′ 5″	14′ 4″	13′ 6″
"	"	Deflection	12′ 1″	11′ 8″	11′ 4″	11′ 0″	10′ 6″	10′ 1″

*Use for Laminated Floors when made of 2x6 and 4x6 pieces.

MAXIMUM SPANS
FOR YELLOW PINE MILL FLOORS

(Actual thickness)

Made of matched and dressed plank.

Fibre stress 1200, 1300, 1500, 1600 and 1800 pounds per square inch; modulus of elasticity 1,620,000 pounds per square inch.

The SUM of the live load and the weight of the floor (see table of properties) was used in calculating the spans.

In the line marked DEFLECTION is given the span which has a deflection of one-thirtieth of an inch per foot of span.

Nominal Thickness	Actual Thickness	Fibre Stress Pounds Per Sq. In.	SPAN IN FEET — LIVE LOAD IN POUNDS PER SQUARE FOOT					
			450#	500#	550#	600#	650#	700#
4"	3 5/8"	1200	6' 9"	6' 5"	6' 1"	5'10"	5' 8"	5' 5"
"	"	1300	7' 0"	6' 8"	6' 4"	6' 1"	5'10"	5' 8"
"	"	1500	7' 6"	7' 2"	6'10"	6' 7"	6' 4"	6' 1"
"	"	1600	7' 9"	7' 5"	7' 1"	6' 9"	6' 6"	6' 3"
"	"	1800	8' 3"	7'10"	7' 6"	7' 2"	6'11"	6' 8"
"	"	Deflection	6' 3"	6' 1"	5'11"	5' 9"	5' 7"	5' 5"
5"	4 5/8"	1200	8' 7"	8' 2"	7' 9"	7' 6"	7' 2"	6'11"
"	"	1300	8'11"	8' 6"	8' 1"	7' 9"	7' 6"	7' 3"
"	"	1500	9' 7"	9' 1"	8' 8"	8' 4"	8' 0"	7' 9"
"	"	1600	9'11"	9' 5"	9' 0"	8' 7"	8' 3"	8' 0"
"	"	1800	10' 6"	10' 0"	9' 6"	9' 2"	8' 9"	8' 6"
"	"	Deflection	8' 0"	7' 8"	7' 6"	7' 3"	7' 1"	6'11"
6"*	5 5/8"*	1200	10' 5"	9'10"	9' 5"	9' 0"	8' 8"	8' 5"
"	"	1300	10'10"	10' 3"	9'10"	9' 5"	9' 1"	8' 9"
"	"	1500	11' 7"	11' 0"	10' 7"	10' 2"	9' 9"	9' 3"
"	"	1600	12' 0"	11' 5"	10'11"	10' 5"	10' 1"	9' 8"
"	"	1800	12' 9"	12' 1"	11' 7"	11' 1"	10' 8"	10' 3"
"	"	Deflection	9' 8"	9' 4"	9' 1"	8'10"	8' 7"	8' 5"

Nominal Thickness	Actual Thickness	Fibre Stress Pounds Per Sq. In.	LIVE LOAD IN POUNDS PER SQUARE FOOT					
			750#	800#	850#	900#	950#	1000#
4"	3 5/8"	1200	5' 3"	5' 1"				
"	"	1300	5' 6"	5' 4"				
"	"	1500	5'11"	5' 8"				
"	"	1600	6' 1"	5'11"				
"	"	1800	6' 5"	6' 3"				
"	"	Deflection	5' 4"	5' 2"				
5"	4 5/8"	1200	6' 8"	6' 6"				
"	"	1300	7' 0"	6' 9"				
"	"	1500	7' 6"	7' 3"				
"	"	1600	7' 9"	7' 6"				
"	"	1800	8' 2"	7'11"				
"	"	Deflection	6' 9"	6' 7"				
6"*	5 5/8"*	1200	8' 1"	7'10"	7' 7"	7' 5"	7' 3"	7' 1"
"	"	1300	8' 5"	8' 2"	7'11"	7' 9"	7' 6"	7' 4"
"	"	1500	9' 1"	8'10"	8' 6"	8' 4"	8' 1"	7'11"
"	"	1600	9' 4"	9' 1"	8'10"	8' 7"	8' 4"	8' 2"
"	"	1800	9'11"	9' 8"	9' 4"	9' 1"	8'10"	8' 8"
"	"	Deflection	8' 3"	8' 1"	7'11"	7' 9"	7' 7"	7' 6"

*Use for Laminated Floors when made of 2x6 and 4x6 pieces.

YELLOW PINE MILL FLOORS.

(Actual size)

Made of matched and dressed plank.

DEFLECTION IN INCHES WITH A LOAD OF 1000 POUNDS UNIFORMLY DISTRIBUTED.

In column headed L/30 is given the deflection in inches which is one-thirtieth of an inch per foot of span.

For a concentrated load of 1000 pounds applied at the center of the span the deflection is 1.6 times that given in the table.

Nominal Thickness 2″		2½″	3″	4″	5″	6″*	L/30
Actual Thickness	1⅝″	2⅛″	2⅝″	3⅝″	4⅝″	5⅝″	
Span in Feet							
4	.2072	.0926					.133
5	.4047	.1810	.0960	.0364			.166
6	.6993	.3127	.1659	.0630	.0303		.200
7	1.1104	.4966	.2634	.1000	.0481	.0267	.233
8	1.6572	.7413	.3932	.1493	.0719	.0399	.266
9	2.3601	1.0554	.5598	.2125	.1023	.0569	.300
10	3.2375	1.4478	.7679	.2916	.1404	.0780	.333
11	4.3090	1.9270	1.0221	.3881	.1868	.1039	.366
12		2.5017	1.3269	.5038	.2426	.1348	.400
13		3.1806	1.6870	.6406	.3084	.1714	.433
14		3.9727	2.1070	.8001	.3852	.2141	.466
15			2.5920	.9841	.4738	.2634	.500
16			3.1450	1.1943	.5750	.3196	.533
17				1.4325	.6897	.3834	.566
18				1.7004	.8187	.4551	.600
19				1.9999	.9629	.5353	.633
20				2.3326	1.1230	.6243	.666
21						.7227	.700
22						.8310	.733

*Use for Laminated Floors when made of 2x6 and 4x6 pieces.

MAXIMUM SPANS
FOR YELLOW PINE LAMINATED FLOORS

(Actual thickness)

Made of planks on edge, laid close.

Fibre stress 1200, 1300, 1500, 1600 and 1800 pounds per square inch; modulus of elasticity 1,620,000 pounds per square inch.

The SUM of the live load and the weight of the floor (see table of properties) was used in calculating the spans.

In the line marked DEFLECTION is given the span which has a deflection of one-thirtieth of an inch per foot of span.

Nominal Thickness	Actual Thickness	Fibre Stress Pounds Per Sq. In.	SPAN IN FEET — LIVE LOAD IN POUNDS PER SQUARE FOOT					
			100#	125#	150#	175#	200#	225#
6"*	5½"*	1200	20′ 3″	18′ 4″	16′11″	15′10″	15′ 1″	14′ 1″
"	"	1300	21′ 1″	19′ 1″	17′ 8″	16′ 5″	15′ 8″	14′ 8″
"	"	1500	22′ 7″	20′ 9″	18′11″	17′ 8″	16′10″	15′ 9″
"	"	1600	23′ 4″	21′ 3″	19′ 7″	18′ 3″	17′ 5″	16′ 4″
"	"	1800	24′ 9″	22′ 6″	20′ 9″	19′ 4″	18′ 5″	17′ 3″
"	"	Deflection	15′ 0″	14′ 1″	13′ 4″	12′ 9″	12′ 3″	11′ 9″
8″	7½″	1200	26′10″	24′ 6″	22′ 8″	21′ 2″	20′ 0″	19′ 0″
"	"	1300	27′11″	25′ 6″	23′ 7″	22′ 1″	20′10″	19′ 9″
"	"	1500	30′ 0″	27′ 5″	25′ 4″	23′ 9″	22′ 4″	21′ 2″
"	"	1600	31′ 0″	28′ 3″	26′ 2″	24′ 6″	23′ 1″	21′11″
"	"	1800	32′10″	30′ 0″	27′ 9″	26′ 0″	24′ 6″	23′ 3″
"	"	Deflection	20′ 1″	19′ 4″	17′11″	17′ 2″	16′ 6″	15′11″

Nominal Thickness	Actual Thickness	Fibre Stress Pounds Per Sq. In.	LIVE LOAD IN POUNDS PER SQUARE FOOT					
			250#	275#	300#	350#	400#	450#
6"*	5½"*	1200	13′ 5″	12′10″	12′ 4″	11′ 6″	10′ 9″	10′ 2″
"	"	1300	14′ 0″	13′ 4″	12′10″	11′11″	11′ 2″	10′ 7″
"	"	1500	15′ 0″	14′ 4″	13′ 9″	12′10″	12′ 0″	11′ 4″
"	"	1600	15′ 6″	14′10″	14′ 3″	13′ 3″	12′ 5″	11′ 9″
"	"	1800	16′ 5″	15′ 9″	15′ 1″	14′ 0″	13′ 2″	12′ 6″
"	"	Deflection	11′ 5″	11′ 1″	10′ 9″	10′ 3″	9′10″	9′ 6″
8″	7½″	1200	18′ 1″	17′ 4″	16′ 7″	15′ 6″	14′ 7″	13′ 9″
"	"	1300	18′10″	18′ 0″	17′ 4″	16′ 1″	15′ 2″	14′ 4″
"	"	1500	20′ 3″	19′ 4″	18′ 7″	17′ 4″	16′ 3″	15′ 5″
"	"	1600	20′10″	20′ 0″	19′ 2″	17′10″	16′ 9″	15′11″
"	"	1800	22′ 2″	21′ 2″	20′ 4″	19′ 0″	17′10″	16′10″
"	"	Deflection	15′ 5″	15′ 0″	14′ 7″	13′11″	13′ 4″	12′10″
10″	9½″	1200			20′10″	19′ 5″	18′ 3″	17′ 4″
"	"	1300			21′ 9″	20′ 3″	19′ 1″	18′ 0″
"	"	1500			23′ 4″	21′ 9″	20′ 5″	19′ 4″
"	"	1600			24′ 1″	22′ 5″	21′ 2″	20′ 0″
"	"	1800			25′ 7″	23′10″	22′ 5″	21′ 2″
"	"	Deflection			18′ 4″	17′ 6″	16′10″	16′ 3″
12″	11½″	1200					22′ 0″	20′10″
"	"	1300					22′11″	21′ 8″
"	"	1500					24′ 7″	23′ 3″
"	"	1600					25′ 4″	24′ 0″
"	"	1800					26′11″	25′ 6″
"	"	Deflection					20′ 3″	19′ 7″

*Use for 2½x6, 3x6 and 6x6 pieces, for 2x6 and 4x6 use table for Mill Floors.

MAXIMUM SPANS
FOR YELLOW PINE LAMINATED FLOORS
(Actual thickness)

Made of planks on edge, laid close.

Fibre stress 1200, 1300, 1500, 1600 and 1800 pounds per square inch; modulus of elasticity 1,620,000 pounds per square inch.

The SUM of the live load and the weight of the floor (see table of properties) was used in calculating the spans.

In the line marked DEFLECTION is given the span which has a deflection of one-thirtieth of an inch per foot of span.

Nominal Thickness.	Actual Thickness.	Fibre Stress. Pounds Per Sq. In.	SPAN IN FEET — LIVE LOAD IN POUNDS PER SQUARE FOOT					
			500 #	550 #	600 #	650 #	700 #	750 #
6"*	5½"*	1200	9′ 8″	9′ 3″	8′10″	8′ 6″	8′ 2″	7′11″
"	"	1300	10′ 1″	9′ 7″	9′ 3″	8′10″	8′ 6″	8′ 3″
"	"	1500	10′10″	10′ 4″	9′11″	9′ 6″	9′ 2″	8′11″
"	"	1600	11′ 2″	10′ 8″	10′ 3″	9′10″	9′ 6″	9′ 2″
"	"	1800	11′10″	11′ 4″	10′10″	10′ 5″	10′ 0″	9′ 9″
"	"	Deflection	9′ 2″	8′11″	8′ 8″	8′ 5″	8′ 3″	8′ 0″
8″	7½″	1200	13′ 1″	12′ 6″	12′ 0″	11′ 7″	11′ 2″	10′10″
"	"	1300	13′ 8″	13′ 0″	12′ 6″	12′ 0″	11′ 7″	11′ 3″
"	"	1500	14′ 8″	14′ 0″	13′ 5″	12′11″	12′ 6″	12′ 1″
"	"	1600	15′ 2″	14′ 5″	13′10″	13′ 4″	12′10″	12′ 5″
"	"	1800	16′ 0″	15′ 4″	14′ 8″	14′ 2″	13′ 5″	13 2″
"	"	Deflection	12′ 5″	12′ 1″	11′ 9″	11′ 5″	11′ 2″	10′11″
10″	9½″	1200	16′ 6″	15′ 9″	15′ 2″	14′ 7″	14′ 1″	13′ 7″
"	"	1300	17′ 2″	16′ 5″	15′ 8″	15′ 2″	14′ 7″	14′ 2″
"	"	1500	18′ 5″	17′ 7″	16′11″	16′ 3″	15′ 8″	15′ 2″
"	"	1600	19′ 0″	18′ 2″	17′ 5″	16′10″	16′ 2″	15′ 8″
"	"	1800	20′ 2″	19′ 3″	18′ 6″	17′10″	17′ 3″	16′ 8″
"	"	Deflection	15′ 8″	15′ 3″	14′10″	14′ 5′	14′ 1″	13′10′
12″	11½″	1200	19′10″	19′ 0″	18′ 2″	17′ 6″	16′11″	16′ 4″
"	"	1300	20′ 8″	19′ 9″	19′ 0″	18′ 3″	17′ 7″	17′ 0″
"	"	1500	22′ 2″	21′ 2″	20′ 4″	19′ 7″	18′11″	18′ 4″
"	"	1600	22′11″	21′11″	21′ 0″	20′ 3″	19′ 7″	18′11″
"	"	1800	24′ 4″	23′ 3″	22′ 4″	21′ 6″	20′ 9″	20′ 1″
"	"	Deflection	18′11″	18′ 5″	17′11″	17′ 5″	17′ 0″	16′ 8″

* Use for 2½x6, 3x6 and 6x6 pieces, for 2x6 and 4x6 use table for Mill Floors.

MAXIMUM SPANS
FOR YELLOW PINE LAMINATED FLOORS
(Actual thickness)

Made of planks on edge, laid close.

Fibre stress 1200, 1300, 1500, 1600 and 1800 pounds per square inch; modulus of elasticity 1,620,000 pounds per square inch.

The SUM of the live load and the weight of the floor (see table of properties) was used in calculating the spans.

In the line marked DEFLECTION is given the span which has a deflection of one-thirtieth of an inch per foot of span.

Nominal Thickness.	Actual Thickness.	Fibre Stress. Pounds per sq. in.	SPAN IN FEET — LIVE LOAD IN POUNDS PER SQUARE FOOT				
			800 #	850 #	900 #	950 #	1000 #
6"*	5½"*	1200	7′ 8″	7′ 6″	7′ 3″	7′ 1″	6′11″
"	"	1300	8′ 1″	7′ 9″	7′ 7″	7′ 4″	7′ 2″
"	"	1500	8′ 7″	8′ 4″	8′ 1″	7′11″	7′ 9″
"	"	1600	8′11″	8′ 8″	8′ 5″	8′ 2″	8′ 0″
"	"	1800	9′ 5″	9′ 2″	8′11″	8′ 8″	8′ 5″
"	"	Deflection	7′10″	7′ 9″	7′ 7″	7′ 5″	7′ 4″
8″	7½″	1200	10′ 6″	10′ 2″	9′10″	9′ 7″	9′ 4″
"	"	1300	10′10″	10′ 7″	10′ 3″	10′ 0″	9′ 9″
"	"	1500	11′ 8″	11′ 4″	11′ 0″	10′ 9″	10′ 6″
"	"	1600	12′ 1″	11′ 8″	11′ 5″	11′ 1″	10′10″
"	"	1800	12′ 9″	12′ 5″	12′ 1″	11′ 9″	11′ 6″
"	"	Deflection	10′ 8″	10′ 6″	10′ 4″	10′ 2″	10′ 0″
10″	9½″	1200	13′ 2″	12′ 9″	12′ 5″	12′ 1″	11′10″
"	"	1300	13′ 8″	13′ 4″	12′11″	12′ 7″	12′ 4″
"	"	1500	14′ 9″	14′ 4″	13′11″	13′ 7″	13′ 3″
"	"	1600	15′ 3″	14′ 9″	14′ 5″	14′ 0″	13′ 8″
"	"	1800	16′ 2″	15′ 8″	15′ 3″	14′10″	14′ 6″
"	"	Deflection	13′ 6″	13′ 3″	13′ 0″	12′ 9″	12′ 7″
12″	11½″	1200	15′ 11″	15′ 5″	15′ 0″	14′ 8″	14′ 4″
"	"	1300	16′ 6″	16′ 1″	15′ 8″	15′ 3″	14′10″
"	"	1500	17′ 9″	17′ 3″	16′ 9″	16′ 4″	16′ 0″
"	"	1600	18′ 4″	17′10″	17′ 4″	16′11″	16′ 6″
"	"	1800	19′ 6″	18′11″	18′ 5″	17′11″	17′ 6″
"	"	Deflection	16′ 4″	16′ 0″	15′ 9″	15′ 6″	15′ 3″

*Use for 2½x6, 3x6 and 6x6 pieces, for 2x6 and 4x6 use table for Mill Floors.

YELLOW PINE LAMINATED FLOORS

(Actual thickness)

Made of planks on edge, laid close.

DEFLECTION IN INCHES WITH A LOAD OF 1000 POUNDS UNIFORMLY DISTRIBUTED.

In column headed L/30 is given the deflection in inches which is one-thirtieth of an inch per foot of span.

For a concentrated load of 1000 pounds applied at the center of the span the deflection is 1.6 times that given in the table.

Nominal Thickness	6"*	8"	10"	12"	L/30
Actual Thickness	5½"*	7½"	9½"	11½"	
Span in Ft.					
7	.0286				.233
8	.0427				.266
9	.0608	.0240			.300
10	.0835	.0329			.333
11	.1111	.0438			.366
12	.1442	.0569	.0280		.400
13	.1834	.0723	.0356		.433
14	.2290	.0903	.0444	.0251	.466
15	.2817	.1111	.0547	.0308	.500
16	.3419	.1348	.0663	.0374	.533
17	.4101	.1617	.0796	.0448	.566
18	.4868	.1920	.0945	.0532	.600
19	.5726	.2258	.1111	.0626	.633
20	.6678	.2634	.1296	.0730	.666
21	.7731	.3049	.1500	.0846	.700
22	.8889	.3505	.1725	.0972	.733
23		.4006	.1971	.1111	.766
24		.4551	.2239	.1262	.800
25		.5144	.2531	.1427	.833
26				.1605	.866
27				.1797	.900

*Use for 2½x6, 3x6 and 6x6 pieces, for 2x6 and 4x6 use table for Mill Floors.

YELLOW PINE COLUMNS

Formulae for determining the strength of columns, both of wood and steel, exist in untold numbers and are about evenly divided between those of a theoretical and empirical nature. The formulae for wooden columns do not vary greatly in results when applied with a uniform fibre stress in compression and it is obviously beyond the limits of this book to consider them all. For this reason two formulae have been selected upon which the following tables are based, one being what is known as a "curved line" formula and the other a "straight line" formula.

FORMULAE

U. S. DEPARTMENT OF AGRICULTURE, DIVISION OF FORESTRY.

$P = F\,(700+15c)/(700+15c+c^2)$

P = unit stress per square inch.

F = compressive strength per square inch with the grain.

l = effective length of column in inches.

d = least side or diameter in inches.

$c = l/d$.

The above is a "curved line" formula.

WINSLOW FORMULA

Unit stress per square inch $= C\,(1 - l/80d)$

C = compressive strength per square inch with the grain.

l = effective length of column in inches.

d = least side or diameter in inches.

This formula is proposed by Mr. Benj. E. Winslow, Mem. Am. Soc. C. E., taken from Winslow's Tables (McGraw-Hill) and is a "straight line" formula which has many practical working advantages and was incorporated in the Chicago Building Ordinance passed December, 5, 1910.

The work performed by wooden columns in building is under such simple and direct conditions of loading with square end bearings, that the consideration and use of the more complicated theoretical formulae is not justified. The above formulae have been extensively and satisfactorily used.

YELLOW PINE COLUMNS

(Actual size)

SAFE LOADS IN TONS OF 2000 POUNDS
Based on the formula of the
U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF FORESTRY.
Square end bearing and symmetrically loaded.
For Formula see page 48.

Nominal Size. Inches	Actual Size. Inches	Area Sq. In.	l/d	Length in Feet.	Compression Parallel to the Grain. Pounds per Square Inch			
					1000	1100	1300	1500
6x6	5½x 5½	30¼	17.5	8	11.50	12.65	14.95	17.25
"	"	"	21.8	10	10.34	11.37	13.44	15.51
"	"	"	26.2	12	9.29	10.22	12.08	13.94
"	"	"	30.5	14	8.39	9.23	10.91	12.59
8x8	7½x 7½	56¼	12.8	8	23.76	26.13	30.88	35.63
"	"	"	16.0	10	22.11	24.32	28.74	33.16
"	"	"	19.2	12	20.48	22.52	26.62	30.72
"	"	"	22.4	14	18.95	20.84	24.63	28.43
"	"	"	25.6	16	17.52	19.27	22.77	26.28
"	"	"	28.8	18	16.28	17.90	21.16	24.42
"	"	"	32.0	20	15.06	16.56	19.57	22.59
10x10	9½x9½	90¼	10.1	8	40.29	44.32	52.38	60.44
"	"	"	12.6	10	38.29	42.12	49.78	57.44
"	"	"	15.2	12	36.21	39.83	47.07	54.31
"	"	"	17.7	14	34.06	37.46	44.27	51.09
"	"	"	20.2	16	32.08	35.29	41.71	48.13
"	"	"	22.7	18	30.19	33.21	39.25	45.29
"	"	"	25.3	20	28.32	31.15	36.81	42.47
12x12	11½x11½	132¼	8.3	8	61.02	67.12	79.32	91.53
"	"	"	10.4	10	58.70	64.57	76.31	88.05
"	"	"	12.5	12	56.21	61.83	73.07	84.31
"	"	"	14.6	14	53.68	59.04	69.78	80.52
"	"	"	16.7	16	51.11	56.22	66.44	76.66
"	"	"	18.8	18	48.60	53.46	63.18	72.90
"	"	"	20.9	20	46.20	50.82	60.06	69.30
14x14	13½x13½	182¼	7.1	8	85.75	94.32	111.47	128.62
"	"	"	8.9	10	83.19	91.51	108.15	124.79
"	"	"	10.7	12	80.46	88.50	104.59	120.68
"	"	"	12.4	14	77.66	85.43	100.96	116.49
"	"	"	14.2	16	74.63	82.09	97.02	111.94
"	"	"	16.0	18	71.62	78.78	93.11	107.43
"	"	"	17.8	20	68.61	75.47	89.19	102.91
16x16	15½x15½	240¼	6.2	8	114.57	126.02	148.94	171.86
"	"	"	7.7	10	111.95	123.14	145.53	167.92
"	"	"	9.3	12	108.95	119.84	141.63	163.42
"	"	"	10.8	14	105.80	116.38	137.54	158.70
"	"	"	12.4	16	102.34	112.57	133.03	153.51
"	"	"	14.0	18	98.83	108.71	128.48	148.24
"	"	"	15.5	20	95.49	105.04	124.14	143.24
18x18	17½x17½	306¼	5.5	8	147.45	162.19	191.68	221.17
"	"	"	6.9	10	144.55	159.00	187.91	216.82
"	"	"	8.2	12	141.48	155.62	183.91	212.21
"	"	"	9.6	14	138.11	151.92	179.54	207.16
"	"	"	11.0	16	134.29	147.72	174.58	201.44
"	"	"	12.3	18	130.76	143.83	169.98	196.13
"	"	"	13.7	20	126.78	139.46	164.82	190.18

YELLOW PINE COLUMNS

(Actual size)

SAFE STRENGTH IN POUNDS PER SQUARE INCH

For various values of *l/d*
Based on the formula of the

U. S. DEPARTMENT OF AGRICULTURE, DIVISION OF FORESTRY.

Square end bearing and symmetrically loaded. For formula see page 48.

l/d	COMPRESSION PARALLEL TO THE GRAIN POUNDS PER SQUARE INCH					
	1000	1100	1200	1300	1400	1500
5	969	1065	1162	1259	1356	1453
6	956	1051	1147	1242	1338	1433
7	942	1036	1130	1224	1318	1413
8	927	1019	1112	1205	1298	1391
9	912	1003	1094	1185	1276	1367
10	895	984	1074	1163	1253	1342
11	877	964	1052	1140	1228	1316
12	859	945	1031	1117	1203	1289
13	841	925	1009	1093	1178	1263
14	823	905	987	1069	1151	1233
15	804	884	964	1045	1126	1207
16	786	864	943	1021	1100	1178
17	768	844	921	998	1075	1152
18	749	824	899	974	1049	1124
19	732	805	878	951	1024	1098
20	714	785	857	928	1000	1072
21	697	767	837	907	976	1045
22	680	748	816	884	952	1020
23	664	730	797	863	930	996
24	648	712	777	842	907	972
25	632	695	758	822	885	948
26	617	678	740	802	864	926
27	602	662	722	782	842	903
28	588	646	705	764	823	882
29	574	631	689	746	804	862
30	561	617	673	729	785	841

YELLOW PINE COLUMNS

(Actual size)

SAFE LOADS IN TONS OF 2000 POUNDS

Based on the

WINSLOW FORMULA

(Chicago Building Ordinance)

Square end bearing and symmetrically loaded.
For formula, see Page 48.

Nominal Size Inches	Actual Size Inches	Area Sq. In.	l/d.	Length in Feet	Compression Parallel to the Grain Pounds per Square Inch			
					1000	1100	1300	1500
6x 6	5½x 5½	30¼	17.5	8	11.82	13.00	15.36	17.72
"	"	"	21.8	10	11.01	12.11	14.31	16.51
"	"	"	26.2	12	10.18	11.19	13.23	15.27
"	"	"	30.5	14	9.35	10.29	12.15	14.01
8x 8	7½x 7½	56¼	12.8	8	23.64	26.00	30.73	35.45
"	"	"	16.0	10	22.50	24.75	29.25	33.75
"	"	"	19.2	12	21.37	23.51	27.79	32.07
"	"	"	22.4	14	20.25	22.27	26.31	30.35
"	"	"	25.6	16	19.12	21.03	24.85	28.67
"	"	"	28.8	18	18.00	19.80	23.40	27.00
"	"	"	32.0	20	16.87	18.56	21.94	25.32
10x10	9½x 9½	90¼	10.1	8	39.42	43.36	51.24	59.13
"	"	"	12.6	10	38.03	41.83	49.43	57.05
"	"	"	15.2	12	36.55	40.20	47.51	54.82
"	"	"	17.7	14	35.20	38.72	45.76	52.80
"	"	"	20.2	16	33.84	37.22	43.99	50.75
"	"	"	22.7	18	32.32	35.55	42.01	48.48
"	"	"	25.3	20	30.85	33.93	40.10	46.27
12x12	11½x11½	132¼	8.3	8	59.51	65.46	77.36	89.26
"	"	"	10.4	10	57.53	63.28	74.78	86.29
"	"	"	12.5	12	55.78	61.36	72.52	83.68
"	"	"	14.6	14	54.10	59.51	70.33	81.15
"	"	"	16.7	16	52.24	57.46	67.91	78.35
"	"	"	18.8	18	50.58	55.64	65.76	75.88
"	"	"	20.9	20	48.93	53.82	63.60	73.39
14x14	13½x13½	182¼	7.1	8	82.93	91.22	107.80	124.39
"	"	"	8.9	10	81.10	89.21	105.43	121.65
"	"	"	10.7	12	79.27	87.20	103.06	118.91
"	"	"	12.4	14	76.96	84.65	100.04	115.43
"	"	"	14.2	16	74.97	82.46	97.46	112.46
"	"	"	16.0	18	72.90	80.19	94.77	109.35
"	"	"	17.8	20	71.07	78.18	92.40	106.62
16x16	15½x15½	240¼	6.2	8	110.84	121.92	144.09	166.25
"	"	"	7.7	10	109.00	119.90	141.70	163.50
"	"	"	9.3	12	106.15	116.76	137.99	159.22
"	"	"	10.8	14	103.86	114.24	135.01	155.78
"	"	"	12.4	16	101.44	111.58	131.87	152.15
"	"	"	14.0	18	99.05	108.95	128.76	148.57
"	"	"	15.5	20	96.86	106.55	125.92	145.29
18x18	17½x17½	306¼	5.5	8	142.55	156.80	185.31	213.82
"	"	"	6.9	10	139.90	153.89	181.87	209.85
"	"	"	8.2	12	137.54	151.29	178.80	206.31
"	"	"	9.6	14	134.75	148.22	175.17	202.12
"	"	"	11.0	16	132.11	145.32	171.74	198.16
"	"	"	12.3	18	129.74	142.71	168.66	194.60
"	"	"	13.7	20	127.09	139.80	165.22	190.64

YELLOW PINE COLUMNS

(Actual size)

SAFE STRENGTH IN POUNDS PER SQUARE INCH

For various values of l/d

Based on the
WINSLOW FORMULA
(Chicago Building Ordinance)

Square end bearing and symmetrically loaded.
For formula, see page 48.

l/d	COMPRESSION PARALLEL TO THE GRAIN POUNDS PER SQUARE INCH					
	1000	1100	1200	1300	1400	1500
5	938	1031	1125	1219	1312	1406
6	925	1017	1109	1202	1295	1387
7	913	1004	1095	1186	1277	1369
8	900	990	1080	1170	1260	1350
9	887	975	1064	1153	1242	1331
10	875	962	1050	1137	1225	1312
11	862	948	1034	1120	1206	1292
12	850	935	1020	1105	1190	1275
13	837	921	1005	1089	1173	1257
14	825	907	990	1072	1155	1237
15	812	893	974	1055	1136	1217
16	800	880	960	1040	1120	1200
17	787	866	945	1024	1103	1182
18	775	853	930	1008	1085	1163
19	762	838	914	990	1066	1142
20	750	825	900	975	1050	1125
21	737	811	885	958	1031	1105
22	725	798	870	943	1015	1088
23	712	784	855	926	997	1068
24	700	770	840	910	980	1050
25	687	756	824	893	961	1030
26	675	743	810	878	945	1013
27	662	728	794	860	926	992
28	650	715	780	845	910	975
29	637	701	765	829	893	957
30	625	687	750	812	875	937

SQUARE WOODEN COLUMNS

(Carnegie Steel Co., Pocket Companion, 21st Edition)

Safe Loads in Thousands of Pounds

American Railway Engineering Association Formulas

	Length, Feet	Side of Square, Inches								
		4	6	8	10	12	14	16	18	20
LONGLEAF PINE, WHITE OAK 1300 (1—1/60d)		15.6								
	5	15.6								
	6	14.6								
	7	13.5	35.1							
	8	12.5	34.3							
	9	11.4	32.8	62.4						
	10	10.4	31.2	62.4						
	11		29.6	60.3						
	12		28.1	58.2	97.5					
	14		25.0	54.1	93.6	140.4				
	16			49.9	88.4	137.3	191.1			
	18			45.8	83.2	131.0	189.3	249.6		
	20			41.6	78.0	124.8	182.0	249.6	315.9	390.0
DOUGLAS FIR, WESTERN HEMLOCK 1200 (1—1/60d)		14.4								
	5	14.4								
	6	13.4								
	7	12.5	32.4							
	8	11.5	31.7							
	9	10.6	30.2	57.6						
	10	9.6	28.8	57.6						
	11		27.4	55.7						
	12		25.9	53.8	90.0					
	14		23.0	49.9	86.4	129.6				
	16			46.1	81.6	126.7	176.4			
	18			42.2	76.8	121.0	174.7	230.4		
	20			38.4	72.0	115.2	168.0	230.4	291.6	360.0
SHORTLEAF PINE, SPRUCE 1100 (1—1/60d)		13.2								
	5	13.2								
	6	12.3								
	7	11.4	29.7							
	8	10.6	29.0							
	9	9.7	27.7	52.8						
	10	8.8	26.4	52.8						
	11		25.1	51.0						
	12		23.8	49.3	82.5					
	14		21.1	45.8	79.2	118.8				
	16			42.2	74.8	116.2	161.7			
	18			38.7	70.4	110.9	160.2	211.2		
	20			35.2	66.0	105.6	154.0	211.2	267.3	300.0
WHITE PINE, TAMARACK 1000 (1—1/60d)		12.0								
	5	12.0								
	6	11.2								
	7	10.4	27.0							
	8	9.6	26.4							
	9	8.8	25.2	48.0						
	10	8.0	24.0	48.0						
	11		22.8	46.4						
	12		21.6	44.8	75.0					
	14		19.2	41.6	72.0	108.0				
	16			38.4	68.0	105.6	147.0			
	18			35.2	64.0	100.8	145.6	192.0		
	20			32.0	60.0	96.0	140.0	192.0	243.0	330.0

Loads in small figures above horizontal lines are the maximum allowable safe loads.

ROUND WOODEN COLUMNS

(Carnegie Steel Co., Pocket Companion, 21st Edition)

Safe Loads in Thousands of Pounds

American Railway Engineering Association Formulas

	Length, Feet	Diameter, Inches								
		4	6	8	10	12	14	16	18	20
LONGLEAF PINE, WHITE OAK 1300 (1—1/60d)	5	12.3								
	6	12.3								
	7	11.4								
	8	10.6	27.6							
	9	9.8	27.0							
	10	9.0	25.7	49.0						
	11	8.2	24.5	49.0						
	12		23.3	47.4						
	14		22.1	45.7	76.6					
	16		19.6	42.5	73.5	110.3				
	18			39.2	69.4	107.8	150.1			
	20			35.9	65.3	102.9	148.7	196.0		
				32.7	61.3	98.0	142.9	196.0	248.1	306.3
DOUGLAS FIR, WESTERN HEMLOCK 1200 (1—1/60d)	5	11.3								
	6	11.3								
	7	10.6								
	8	9.8	25.4							
	9	9.1	24.9							
	10	8.3	23.7	45.2						
	11	7.5	22.6	45.2						
	12		21.5	43.7						
	14		20.4	42.2	70.7					
	16		18.1	39.2	67.9	101.8				
	18			36.2	64.1	99.5	138.5			
	20			33.2	60.3	95.0	137.2	181.0		
				30.2	56.5	90.5	132.0	181.0	229.0	282.7
SHORTLEAF PINE, SPRUCE 1100 (1—1/60d)	5	10.4								
	6	10.4								
	7	9.7								
	8	9.0	23.3							
	9	8.3	22.8							
	10	7.6	21.8	41.5						
	11	6.9	20.7	41.5						
	12		19.7	40.1						
	14		18.7	38.7	64.8					
	16		16.6	35.9	62.2	93.3				
	18			33.2	58.7	91.2	127.0			
	20			30.4	55.3	87.1	125.8	165.9		
				27.6	51.8	82.9	121.0	165.9	209.9	259.2
WHITE PINE, TAMARACK 1000 (1—1/60d)	5	9.4								
	6	9.4								
	7	8.8								
	8	8.2	21.2							
	9	7.5	20.7							
	10	6.9	19.8	37.7						
	11	6.3	18.9	37.7						
	12		17.9	36.4						
	14		17.0	35.2	58.9					
	16		15.1	32.7	56.5	84.8				
	18			30.2	53.4	82.9	115.5			
	20			27.6	50.3	79.2	114.4	150.8		
				25.1	47.1	75.4	110.0	150.8	190.9	235.6

Loads in small figures above horizontal lines are the maximum allowable safe loads.

GENERAL FORMULAE FOR FLEXURE OF BEAMS

NOTATION

A = area of section in square inches.
b = breadth of beam in inches.
C = coefficient of strength.
d = depth of beam in inches.
D = deflection of beam in inches due to loads W or P.
E = modulus of elasticity in pounds per square inch.
f = stress in pounds per square inch in extreme fibres.
I = moment of inertia in inches^4.
L = span in feet.
l = span in inches.
M = bending moment.
N = coefficient of deflection.
n = distance of center of gravity of section from extreme fibre in inches.
P = load in pounds concentrated at any point.
S = section modulus in inches^3.
s = allowable shear in direction of the grain in pounds per square inch.
W = total distributed load in pounds.
w = load in pounds per lineal inch of span.

FORMULAE

For rectangular or square beams with neutral axis perpendicular to the depth at center:

$$I = bd^3/12. \qquad S = I/n = bd^2/6. \qquad M = fS.$$

SAFE LOADS

(I) For beam supported at both ends and uniformly loaded:
  (1) $M = Wl/8$ hence $W = 8fS/l$.
  (2) $C = 8fS/l$ where $l = 12''$ therefore $C = 2fS/3$.

(II) For beam supported at both ends with concentrated load applied at center of span:
  (3) $M = Pl/4$ hence $P = 4fS/l$.
  (4) $C = 4fS/l$ where $l = 12''$ therefore $C = fS/3$.

(III) For beam supported at both ends with concentrated load applied in two equal parts at third points of span: where P = sum of the two equal loads,
  (5) $M = P/2 \times l/3$ hence $P = 6fS/l$.
  (6) $C = 6fS/l$ where $l = 12''$ therefore $C = fS/2$.

The safe load for any span in feet $= C/L$, C corresponding to the manner of loading.

DEFLECTIONS

(IV) For beam supported at both ends and uniformly loaded:

(7) $D=5Wl^3/384EI$, hence for square or rectangular beams

(8) $$D=\frac{270\times WL^3}{Ebd^3}$$

(V) To find the load which will cause a deflection of one-thirtieth of an inch per foot of span make $D=L/30$, hence

(9) $$W=\frac{Ebd^3}{8100L^2}$$

(VI) For a beam supported at both ends with concentrated load applied at center of span:

(10) $D=Pl^3/48EI$, hence for a square or rectangular beam

(11) $$D=\frac{432PL^3}{Ebd^3}$$

(VII) To find the load which will cause a deflection of one-thirtieth of an inch per foot of span make $D=L/30$, hence

(12) $$P=\frac{Ebd^3}{12960L^2}$$

(VIII) For a beam supported at both ends with two equal concentrated loads applied at the third points of the span:

where P=the sum of the two equal loads

(13) $D=23Pl^3/1296EI$, hence for a square or rectangular beam

(14) $$D=\frac{368WL^3}{Ebd^3}$$

(IX) To find the load which will produce a deflection of one-thirtieth of an inch per foot of span make $D=L/30$, hence

(15) $$P=\frac{Ebd^3}{11040L^2}$$

COEFFICIENT OF DEFLECTION.

The coefficients of deflection given in the tables of properties of beams, mill and laminated floors were obtained by the following formulae:

(X) For uniformly distributed load (7):

(16) $Wl^3/76.8EI$.

(XI) For load concentrated at center of span (10):

(17) $Pl^3/48EI$.

(XII) For two equal loads concentrated at third points of span (total load=P) (13):

(18) $23Pl^3/1296EI$.

in all of the above
W and P=1000 pounds.
l=12 inches.

These coefficients are the deflections in inches of a beam one foot long with a load of 1000 pounds. The deflection of a beam for any load and span is the product of the proper coefficient, the cube of the span in feet and the number of 1000-pound units in the given load. See page 5.

MAXIMUM SPANS FOR BEAMS, MILL AND LAMINATED FLOORS

(XIII) For a beam supported at both ends and uniformly loaded:

the uniformly distributed load=wl=12wL.

(19) $wL^2/8=fS/144$ hence

(20) $L^2=fS/18w$.

(XIV) For a beam supported at both ends with concentrated load applied at center of span:

(21) $PL/4=fS/12$ hence

(22) $L=fS/3P$.

(XV) For a beam supported at both ends with two equal concentrated loads applied at the third points of the span:

P=sum of two equal loads

(23) $PL/6=fS/12$ hence

(24) $L=fS/2P$.

SPANS LIMITED BY A GIVEN DEFLECTION.

Deflection limited to one-thirtieth of an inch per foot of span.

(XVI) For a beam supported at both ends and uniformly loaded:

In formula 9 make W=12wL hence

(25) $$L^3=\frac{Ebd^3}{97{,}200w}$$

(XVII) For a beam supported at both ends with concentrated load applied at center of span:

From formula 12.

$$(26)\quad L^2=\frac{Ebd^3}{12960P}$$

(XVIII) For a beam supported at both ends with two equal concentrated loads applied at the third points of the span:

From formula 15.
P=the sum of the two equal loads.

$$(27)\quad L^2=\frac{Ebd^3}{11040P}$$

HORIZONTAL SHEAR

The intensity of the shearing stress at any point in a section is the same for the vertical shear and the horizontal shear. The maximum horizontal shear for a square or rectangular beam, per unit of neutral surface, is

$$(28)\quad H=3V/2bd,$$

in which
V=the vertical shear in the section.

For symmetrically loaded beams substitute $W/2=V$ and substitute $s=H$, then the safe load limited by the resistance to horizontal shear is

$$(29)\quad W=4bds/3.$$

The load limited by the resistance to horizontal shear is the maximum load that can be safely applied to the beam.

BENDING MOMENTS

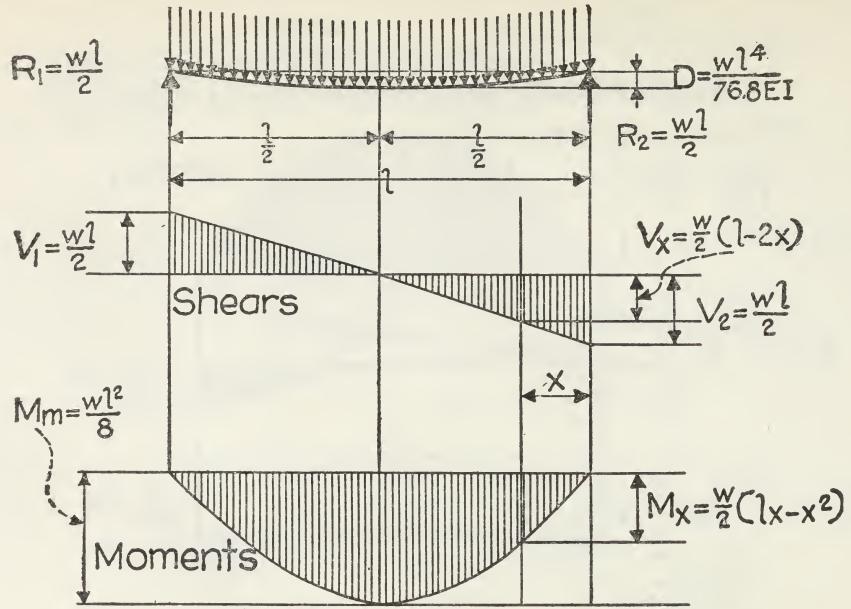
The bending moment of a beam represents the destructive energy of the load on the beam at any point for which the bending moment is computed.

Bending moments are computed in foot pounds or inch pounds as the span is taken in feet or inches respectively.

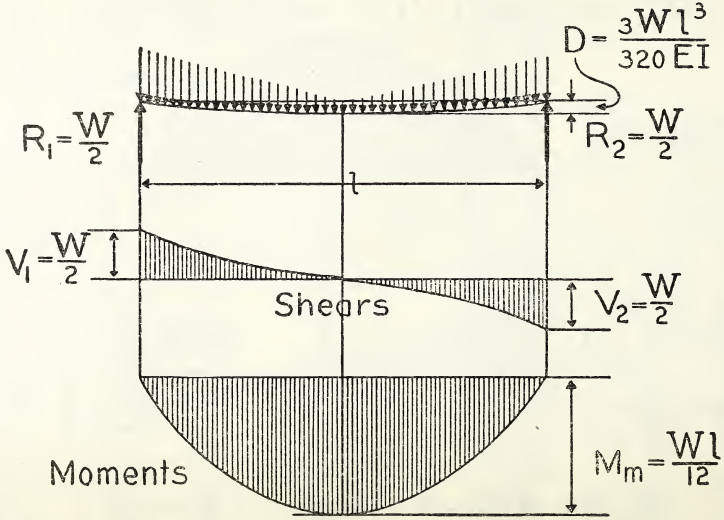
NOTATION

The following formulae are for the effect of the loads only, and to these should be added the effect of the weight of the beam itself.

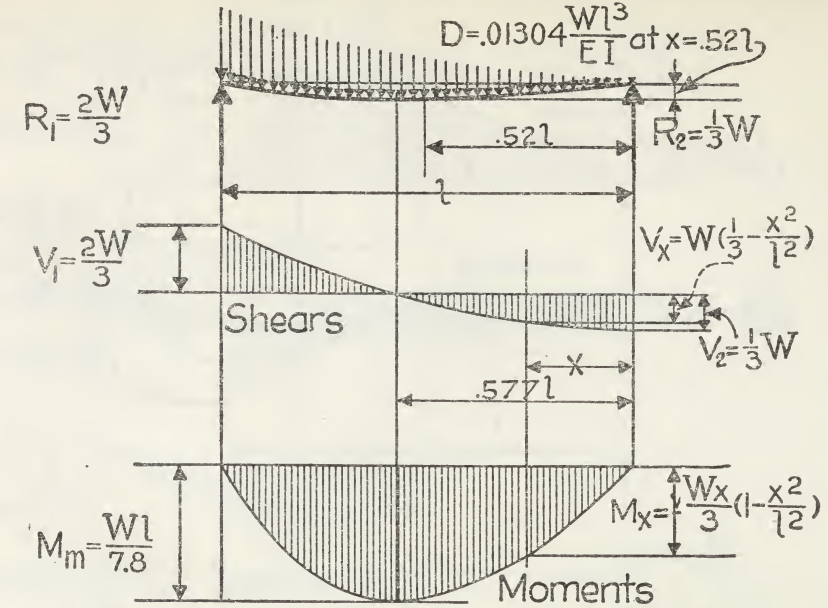
w=uniformly distributed load per unit length.
P=concentrated loads.
l=span of beam.
a, b=fixed lengths along beam.
x, y, etc.=variable distances along beam.
R, R_1, etc.=reactions at supports.
V, V_1, etc.=shears at supports.
M, M_a, M_x, etc.=moments due to loads.
D=deflection in inches.
E=modulus of elasticity of material.
I=moment of inertia of beam.



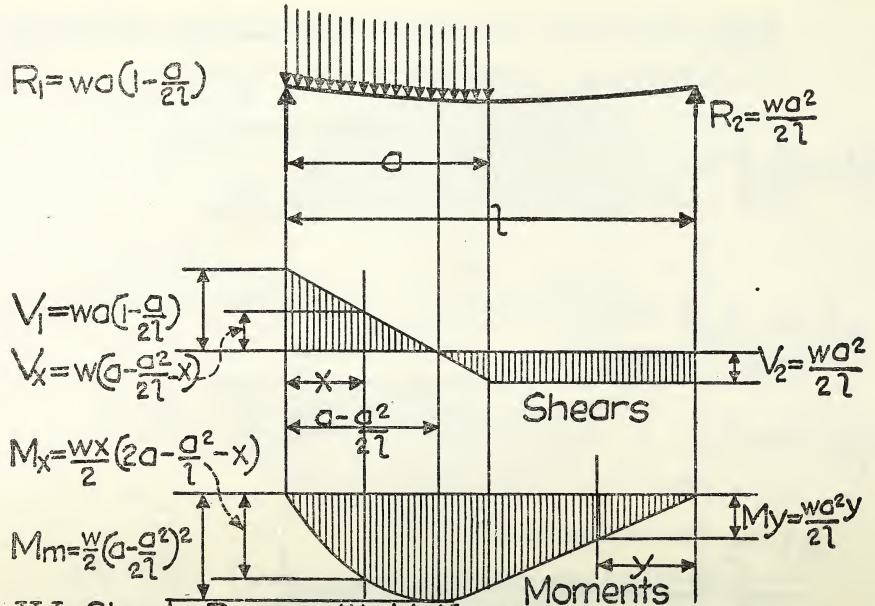
I. Simple Beam with Uniform Load



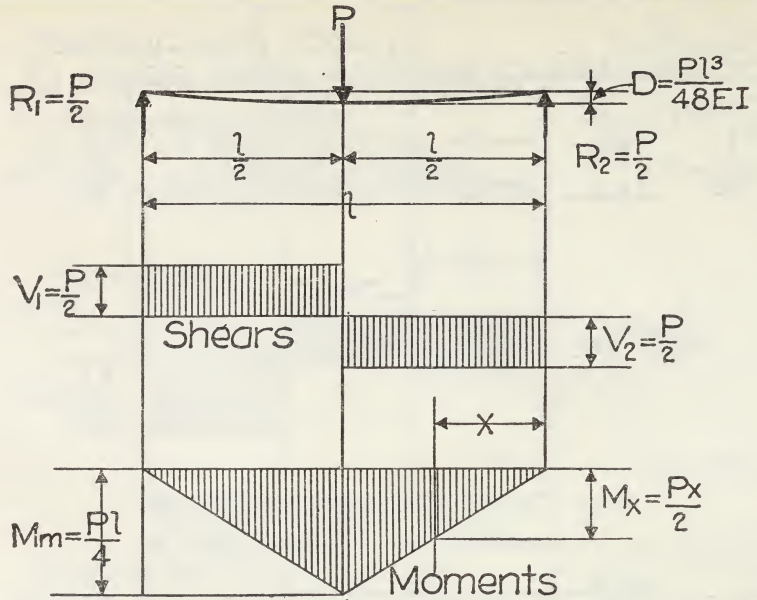
II Simple Beam with Load Decreasing Uniformly from Ends to Center.



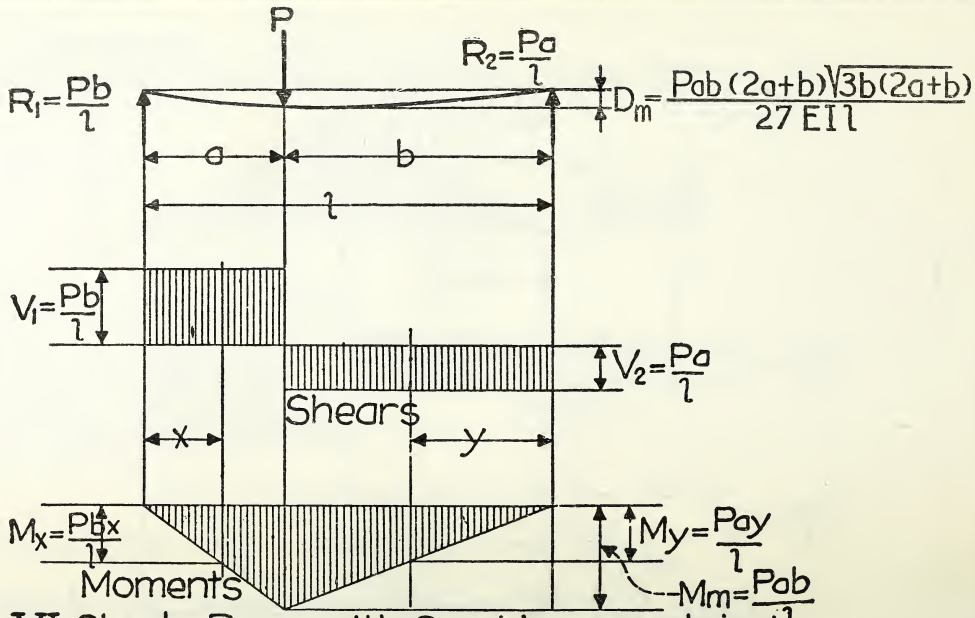
III Simple Beam with Uniformly Varying Load



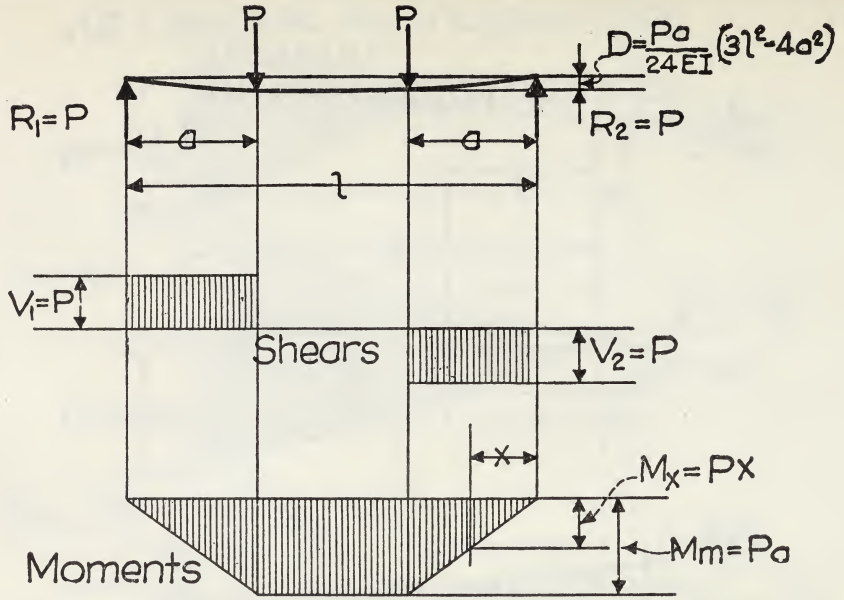
IV. Simple Beam with Uniform Load on Part of Span Only



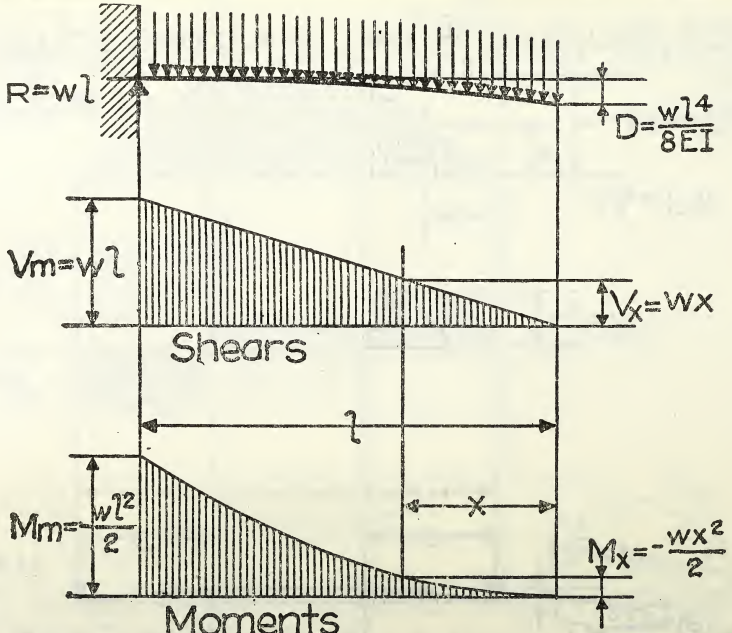
V Simple Beam with Concentrated Load *P* at the Center.



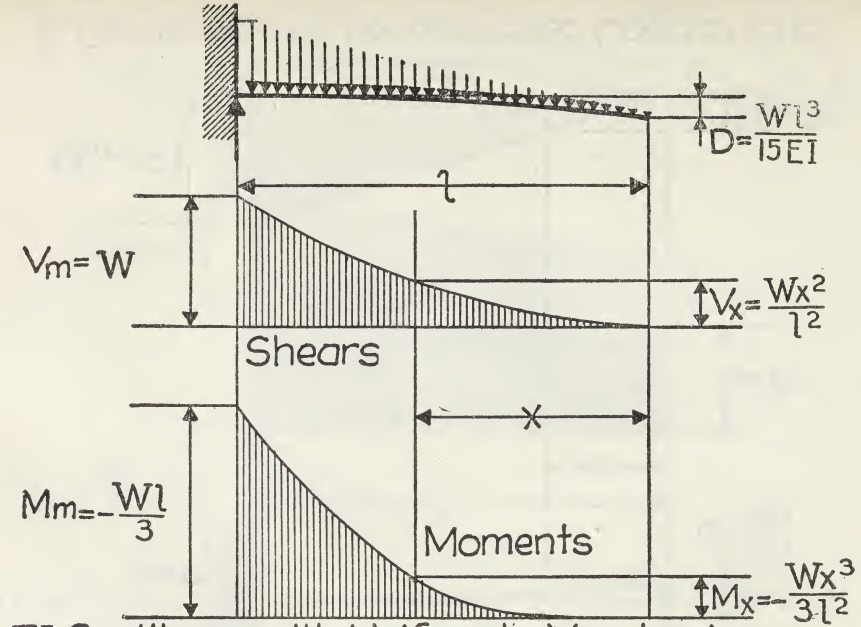
VI Simple Beam with One Unsymmetrical Concentrated Load P



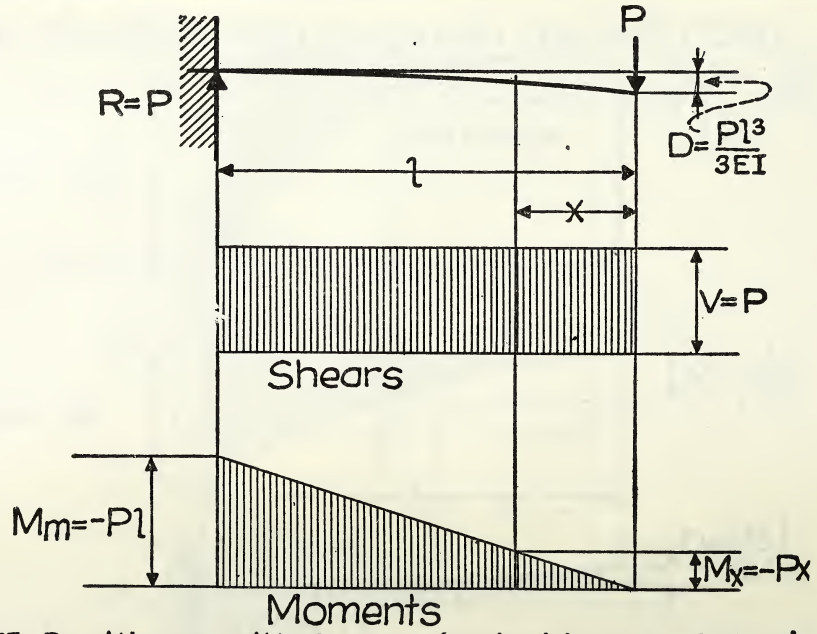
VII Simple Beam with Two Symmetrical Loads



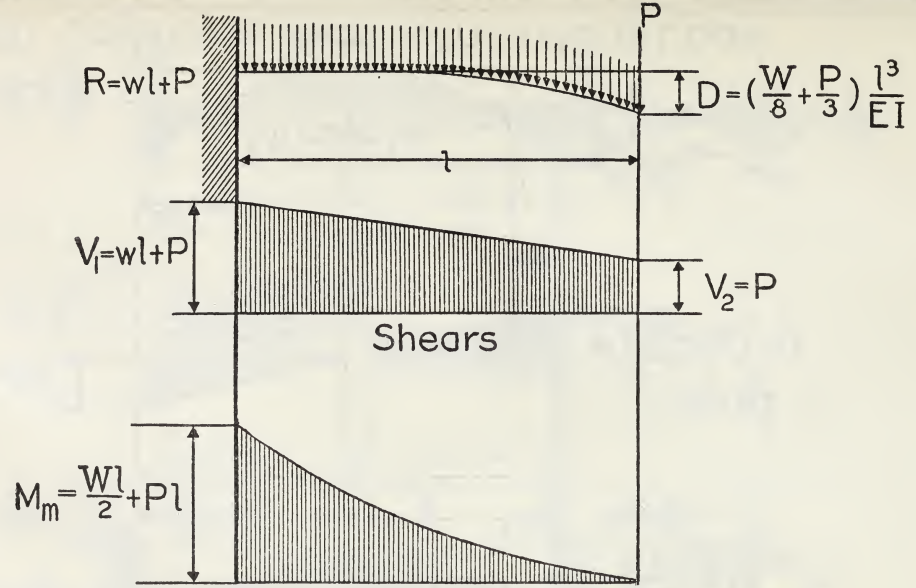
VIII Cantilever with Uniform Load



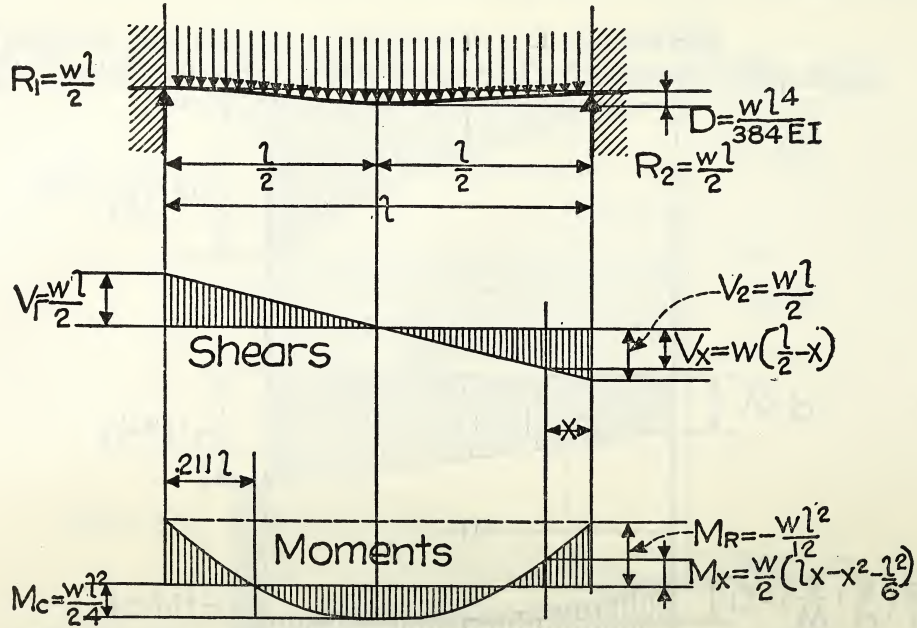
IX Cantilever with Uniformly Varying Load



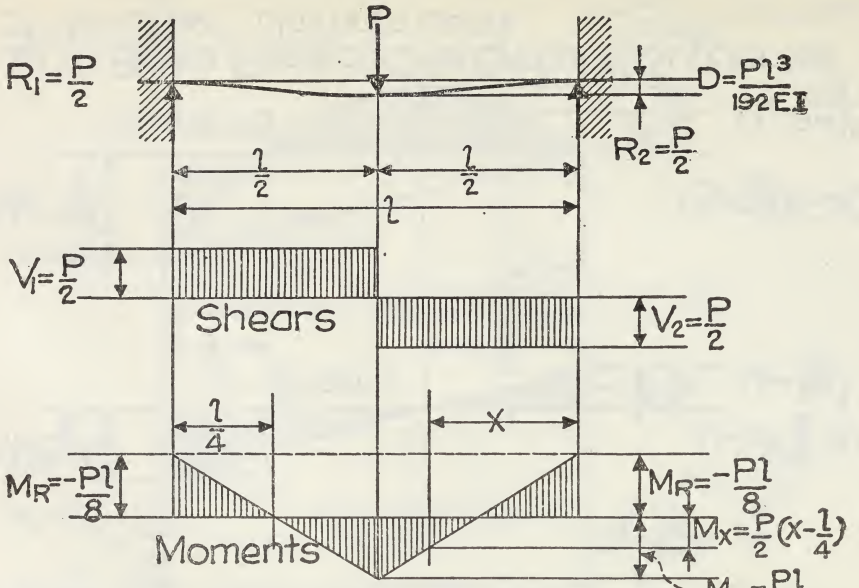
X. Cantilever with Concentrated Load at End



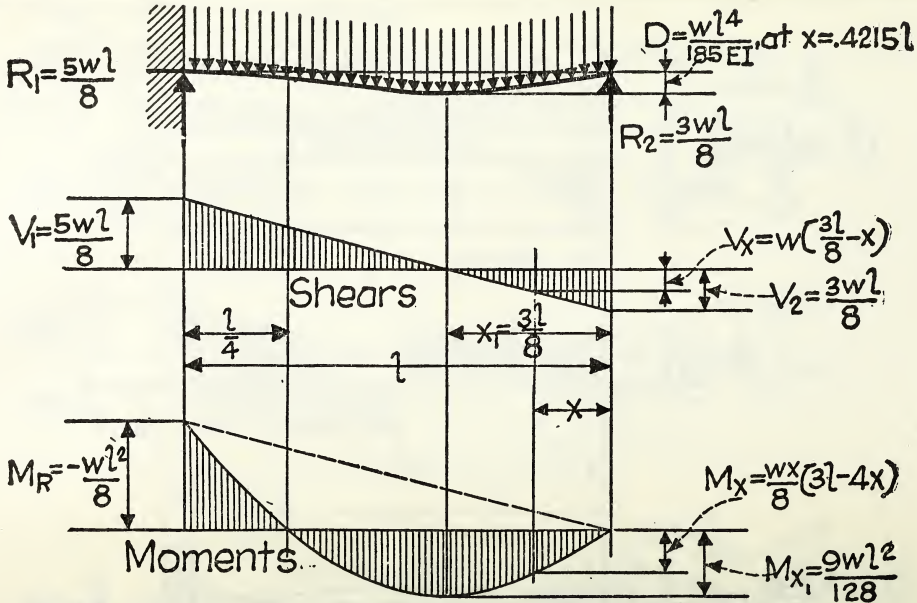
XI Cantilever with Concentrated Load at End with Uniform Weight of Cantilever Considered.



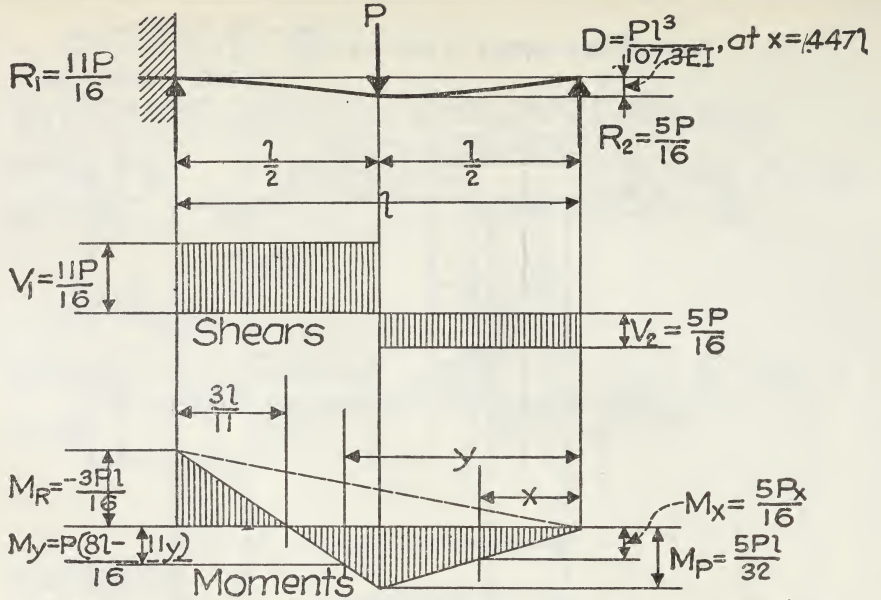
XII. Continuous Beam with Uniform Load



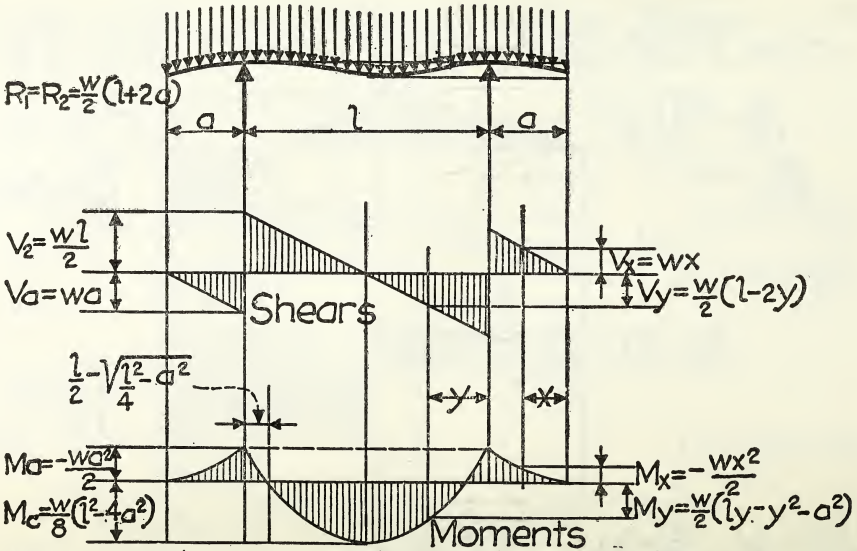
XIII Continuous Beam with Concentrated Load at Center.



XIV. Beam Fixed at One End and Supported at the Other. Uniform Load.



XV. Beam Fixed at One End and Supported at the Other. Concentrated Load at Center.



XVI. Simple Beam with Overhung Ends and Uniform Load.

$M_c = 0$ for $l = 2a$. $M_c = -M_a$ for $l = 2.828a$. $M_c = \frac{wl^2}{8} - M_a$.
If $l > 2.828a$ $M_c > -M_a$.

TRUSSED BEAMS

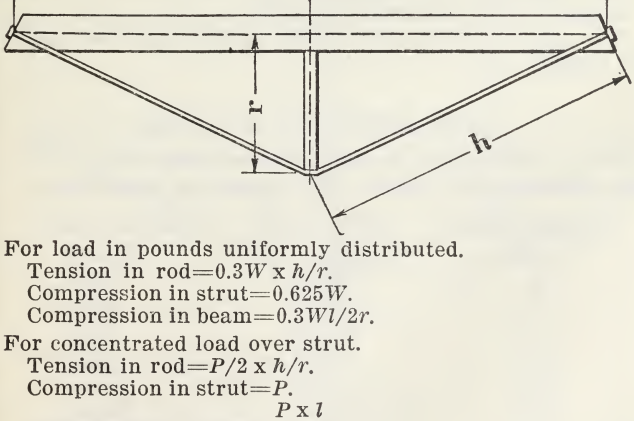
The basis of the tables for trussed beams is the load in pounds uniformly distributed which develops the full strength of the rods, the timbers being proportioned to carry the load thus determined. This will, in some cases, demand an excess of timber as the standard sizes of timbers and rods are assumed without reference to the physical properties of the two materials.

The tables are based on the following:

Tension in rod 14000 pounds per square inch.
Extreme fibre stress in flexure 1800 pounds per square inch.
Horizontal shear 175 pounds per square inch.
Compression parallel to the grain,
For columns under 15 diameters 1000 pounds per square inch.
For columns over 15 diameters the unit stress per square inch $=C(1-l/80d)$, see page 48.
Compression perpendicular to the grain, 350 pounds per square inch.
The rods are not upset and the strength is based on the net area at base of threads.
No allowance is made for initial stress caused by drawing the rods too tight.
It is assumed that the beams are secured against deflection by floor or roof construction.
In the tables, two columns are given under "Size of Strut," one for strut using bearing plate and the other for strut without bearing plate.

FORMULAE

(For notation see page 55).

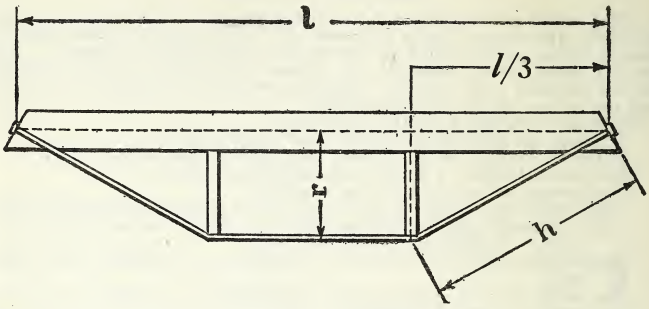


For load in pounds uniformly distributed.

Tension in rod $=0.3W \times h/r$.
Compression in strut $=0.625W$.
Compression in beam $=0.3Wl/2r$.

For concentrated load over strut.

Tension in rod $=P/2 \times h/r$.
Compression in strut $=P$.
Compression in beam $=\dfrac{P \times l}{4r}$



For load in pounds uniformly distributed.

Tension in rod=0.376W x h/r.

Compression in strut=0.376W.

Compression in beam=0.376W x $l/3r$.

For concentrated load over each strut.

Tension in rod=P x h/r.

Compression in strut=P.

Compression in beam=P x $l/3r$.

The safe concentrated load over each strut is 0.367 of the safe uniformly distributed load given in the tables.

The distance "r" is measured from the centre of the beam to the centre of the rod under the strut.

For cast iron struts allow 10000 pounds per square inch of least section.

SAFE STRENGTH OF RODS

(Not upset, net area at base of thread)

Working stress in tension 14000 pounds per square inch.

DIAMETER Inches	NET AREA Sq. in.	SAFE LOAD Pounds
¾	0.302	4200
⅞	0.420	5880
1	0.550	7696
1⅛	0.694	9716
1¼	0.893	12474
1⅜	1.057	14784
1½	1.295	18102
1⅝	1.515	21210
1¾	1.746	24402

The washers at the ends of the rods should have net bearing areas as follows:

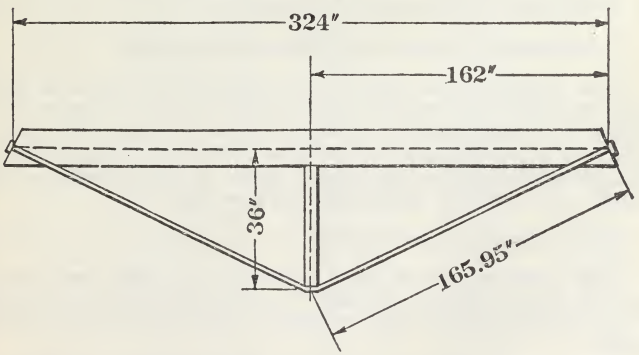
DIAMETER Inches	NET AREA Sq. in.
3/4	4.6
7/8	6.5
1	8.5
1 1/8	9.9
1 1/4	13.8
1 3/8	16.5
1 1/2	20.1
1 5/8	23.5
1 3/4	27.1

The washers must be designed to resist the bending and shearing stresses developed.

EXAMPLE

Design a single strut trussed beam with a 27 foot span to carry 26000 pounds, uniformly distributed. The distance "r" from centre of beam to underside of strut to be 36 inches.

W= 26000.00 pounds
$l/2$= 162.00 inches
r= 36.00 inches
h= 165.95 inches



Tension in rod = $0.3Wxh/r$.
= 35956 pounds.
will require two 1½ inch rods.
Compression in beam = $0.3Wxl/2r$.
= 35100 pounds.

As a beam one half the load $W/2$ is applied to one half of the span $l/2$.

The permissable maximum fibre stress

$$f=f'+f''=1800 \text{ pounds per sq. in.}$$

in which

$f'=M/S$, unit stress due to flexure

$f''=\frac{\text{compression in beam}}{\text{area}}$, unit stress due to compression.

Assume the depth of beam as 14" (13½" actual size).

$$f=M/S+\frac{\text{compression in beam}}{\text{area}}=1800 \text{ pounds per sq. in.}$$

$$\frac{W}{2}\times\frac{l}{2}\times\frac{1}{8}\times\frac{6}{bd^2}+\frac{35100}{b\times d}=1800$$

$$\frac{26000}{2}\times\frac{324}{2}\times\frac{1}{8}\times\frac{6}{b\times(13\frac{1}{2})^2}+\frac{35100}{b\times 13\frac{1}{2}}=1800$$

in which b=6.25 inches.

Therefore a beam 8"x14" is required.

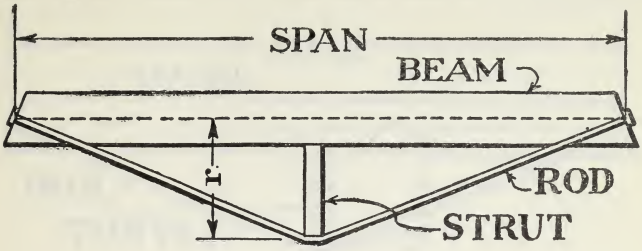
Compression in strut=$0.625W$=16250 pounds.

The section area required by the strut to resist its own stress is 16250/1000=16.25 square inches, which is given by a 4x6 (actual size 3½x5½). But the bearing of the strut on the bottom of the beam governs its size, therefore, using compression perpendicular to the grain, which is 350 pounds to the square inch, we have 16250/350=46.4 sq. in.

This requires a strut 6"x8".

The strut 4x6 can be used provided a bearing plate 6x8 is used on under side of the beam. A steel or cast iron saddle at the bottom of the strut, to form a seat for the rod, is required.

The same methods are used for designing a two-strut trussed beam using the formula for such beams and when considered as a beam one-third of the total load is considered as uniformly distributed over one-third of the span.



SINGLE STRUT TRUSSED BEAMS

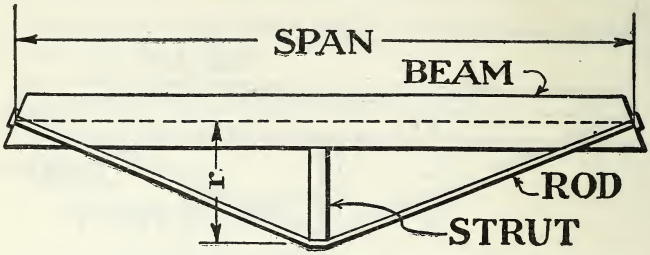
(Actual size)

SAFE LOAD IN POUNDS, UNIFORMLY DISTRIBUTED.

The upper loads and timber sizes are for one rod.

The lower loads and timber sizes are for two rods.

Diam. Rod	"r" in Inches	SPAN 16 FEET				
		Load	Size of Beam	Size of Strut		Size of Bearing Plate
				Without Plate	With Plate	
1"	15	3,958	3¾x 7½	3½x 3½	.....	.....
		7,916	3¾x 9½	3½x 5½	3½x3½	3¾x 4
	21	5,471	5½x 7½	3½x 3½	.....	.....
		10,942	5½x 9½	3½x 5½	3½x3½	4 x 5
	27	6,941	5½x 7½	3½x 3½	.....	.....
		13,882	5½x 9½	5½x 5½	3½x3½	5 x 5
	33	8,344	5½x 7½	3½x 5½	3½x3½	4 x 4
		16,688	5½x 9½	5½x 5½	3½x3½	5 x 6
1¼"	15	6,425	5½x 7½	3½x 3½	.....	.....
		12,850	5½x 9½	5½x 5½	3½x3½	5 x 5
	21	8,881	5½x 7½	3½x 5½	3½x3½	4 x 4
		17,762	5½x11½	5½x 5½	3½x3½	5 x 6
	27	11,266	5½x 9½	3½x 5½	3½x3½	4 x 5
		22,532	5½x13½	5½x 7½	3½x5½	5 x 8
	33	13,544	5½x 9½	5½x 5½	3½x3½	4 x 6
		27,088	5½x13½	5½x 9½	3½x5½	5½x 8½
1½"	15	9,322	5½x 9½	3½x 5½	3½x3½	4 x 4
		18,644	5½x13½	5½x 5½	3½x3½	5 x 6
	21	12,886	5½x 9½	5½x 5½	3½x3½	4 x 6
		25,772	5½x13½	5½x 7½	3½x5½	5 x 9
	27	16,347	5½x11½	5½x 5½	3½x3½	5 x 6
		32,694	5½x15½	5½x 9½	5½x5½	5½x10½
	33	19,653	5½x11½	5½x 7½	3½x3½	5 x 8
		39,306	5½x15½	5½x11½	5½x5½	5½x12
1¾"	15	12,567	5½x 9½	5½x 5½	3½x3½	4 x 6
		25,134	7½x13½	5½x 9½	3½x5½	6 x 8
	21	17,371	5½x11½	5½x 5½	3½x3½	5 x 6
		34,742	7½x13½	5½x11½	5½x5½	7½x 9
	27	22,037	5½x13½	5½x 7½	3½x5½	5 x 8
		44,074	7½x15½	7½x11½	5½x7½	7½x10
	33	26,493	5½x13½	5½x 9½	3½x5½	5½x 8½
		52,986	7½x15½	7½x11½	5½x7½	7½x12



SINGLE STRUT TRUSSED BEAMS

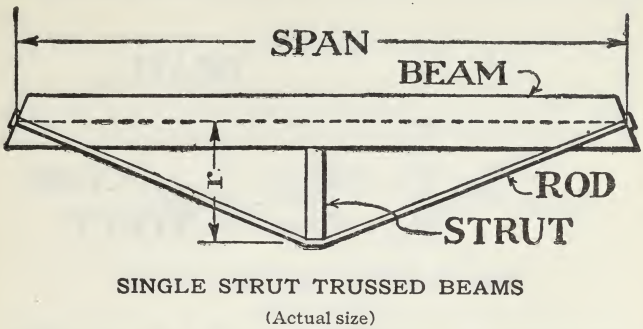
(Actual size)

SAFE LOAD IN POUNDS, UNIFORMLY DISTRIBUTED.

The upper loads and timber sizes are for **one rod.**

The lower loads and timber sizes are for **two rods.**

Diam. Rod	"r" in Inches	SPAN 18 FEET				
		Load	Size of Beam	Size of Strut		Size of Bearing Plate
				Without Plate	With Plate	
1"	15	3,524	3¾x 7½	3½x 3½	.....	.....
		7,048	3¾x 9½	3½x 3½	.....	.....
	21	4,897	5½x 7½	3½x 3½	.....	.....
		9,794	5½x 9½	3½x 5½	3½x3½	4 x 5
	27	6,214	5½x 7½	3½x 3½	.....	.....
		12,428	5½x 9½	5½x 5½	3½x3½	5 x 5
	33	7,490	5½x 7½	3½x 5½	3½x3½	4 x 4
		14,980	5½x 9½	5½x 5½	3½x3½	5 x 5
1¼"	15	5,721	5½x 7½	3½x 3½	.....	.....
		11,442	5½x 9½	3½x 5½	3½x3½	4 x 5
	21	7,948	5½x 7½	3½x 5½	3½x3½	4 x 4
		15,896	5½x11½	3½x 7½	3½x3½	5 x 6
	27	10,087	5½x 9½	3½x 5½	3½x3½	4 x 5
		20,174	5½x11½	5½x 7½	3½x3½	5 x 7
	33	12,157	5½x 9½	5½x 5½	3½x3½	5 x 5
		24,314	5½x13½	5½x 7½	3½x5½	5 x 8
1½"	15	8,301	5½x 9½	3½x 5½	3½x3½	4 x 4
		16,602	5½x13½	5½x 5½	3½x3½	5 x 6
	21	11,533	5½x11½	3½x 5½	3½x3½	4 x 5
		23,066	5½x13½	5½x 7½	3½x5½	5 x 8
	27	14,636	5½x11½	5½x 5½	3½x3½	5 x 5
		29,272	5½x15½	5½x 9½	3½x5½	5 x10
	33	17,640	5½x11½	5½x 5½	3½x3½	5 x 6
		35,280	5½x15½	5½x11½	5½x5½	5½x11½
1¾"	15	11,190	5½x 9½	3½x 5½	3½x3½	4 x 5
		22,380	7½x11½	5½x 7½	3½x5½	5 x 8
	21	15,529	5½x11½	3½x 7½	3½x3½	5 x 6
		31,058	7½x13½	5½x 9½	3½x5½	5½x10
	27	19,730	5½x11½	5½x 7½	3½x3½	5 x 7
		39,460	7½x15½	7½x 9½	5½x5½	7 x10
	33	23,780	5½x13½	5½x 7½	3½x5½	5 x 8
		47,560	7½x15½	7½x11½	5½x5½	7½x11½



SINGLE STRUT TRUSSED BEAMS

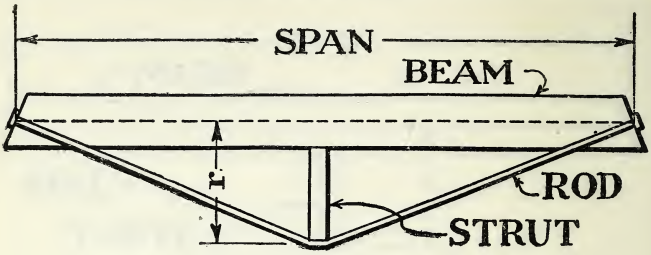
(Actual size)

SAFE LOAD IN POUNDS, UNIFORMLY DISTRIBUTED.

The upper loads and timber sizes are for one rod.

The lower loads and timber sizes are for two rods.

Diam. Rod	"r" in Inches	SPAN 20 FEET				
		Load	Size of Beam	Size of Strut Without Plate	Size of Strut With Plate	Size of Bearing Plate
1"	16	3,378	3¾x 7½	3½x 3½	.....	.....
		6,756	3¾x 9½	3½x 3½	.....	.....
	24	5,032	5½x 7½	3½x 3½	.....	.....
		10,064	5½x 9½	3½x 5½	3½x3½	4 x 5
	32	6,598	5½x 7½	3½x 3½	.....	.....
		13,196	5½x 9½	5½x 5½	3½x3½	4 x 6
	40	8,106	5½x 7½	3½x 5½	3½x3½	4 x 4
		16,212	5½x11½	5½x 5½	3½x3½	5 x 6
1¼"	16	5,483	5½x 7½	3½x 3½	.....	.....
		10,966	5½x 9½	3½x 5½	3½x3½	4 x 5
	24	8,168	5½x 9½	3½x 5½	3½x3½	4 x 4
		16,336	5½x11½	5½x 5½	3½x3½	5 x 6
	32	10,710	5½x 9½	3½x 5½	3½x3½	4 x 5
		21,420	5½x13½	5½x 7½	3½x5½	5 x 8
	40	13,158	5½x11½	5½x 5½	3½x3½	4 x 6
		26,316	5½x13½	5½x 9½	3½x5½	5½x 8½
1½"	16	7,956	5½x 9½	3½x 5½	3½x3½	4 x 4
		15,912	5½x13½	3½x 7½	3½x3½	5 x 6
	24	11,852	5½x11½	3½x 5½	3½x3½	4 x 5
		23,704	5½x13½	5½x 7½	3½x5½	5 x 8
	32	15,541	5½x11½	3½x 7½	3½x3½	5 x 6
		31,082	5½x15½	5½x 9½	3½x5½	5½x10
	40	19,093	5½x13½	5½x 7½	3½x3½	5 x 8
		38,186	7½x15½	5½x11½	5½x5½	7 x10
1¾"	16	10,725	5½x 9½	3½x 5½	3½x3½	4 x 5
		21,450	7½x13½	5½x 7½	3½x5½	5 x 8
	24	15,977	5½x11½	3½x 7½	3½x3½	5 x 6
		31,954	7½x15½	5½x 9½	3½x5½	6 x 9
	32	20,950	5½x13½	5½x 7½	3½x3½	5 x 7
		41,900	7½x15½	7½x 9½	5½x5½	7 x11
	40	25,748	5½x13½	5½x 9½	3½x5½	5½x 8½
		51,496	9½x15½	9½x11½	5½x7½	9 x11



SINGLE STRUT TRUSSED BEAMS

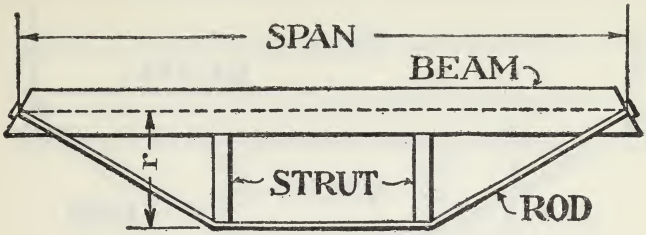
(Actual size)

SAFE LOAD IN POUNDS, UNIFORMLY DISTRIBUTED.

The upper loads and timber sizes are for one rod.

The lower loads and timber sizes are for two rods.

Diam. Rod	"r" in Inches	SPAN 22 FEET				
		Load	Size of Beam	Size of Strut		Size of Bearing Plate
				Without Plate	With Plate	
1"	16	3,074	3¾x 7½	3½x 3½	.....	.....
		6,148	3¾x 9½	3½x 3½	.....	.....
	24	4,580	5½x 7½	3½x 3½	.....	.....
		9,160	5½x 9½	3½x 5½	3½x3½	4 x 4
	32	6,026	5½x 7½	3½x 3½	.....	.....
		12,052	5½x 9½	3½x 5½	3½x3½	4 x 5
	40	7,424	5½x 7½	3½x 5½	3½x3½	4 x 4
		14,848	5½x11½	5½x 5½	3½x3½	5 x 5
1¼"	16	4,990	5½x 7½	3½x 3½	.....	.....
		9,980	5½x 9½	3½x 5½	3½x3½	4 x 5
	24	7,434	5½x 9½	3½x 3½	.....	.....
		14,868	5½x11½	5½x 5½	3½x3½	5 x 5
	32	9,781	5½x 9½	3½x 5½	3½x3½	4 x 5
		19,562	5½x13½	5½x 7½	3½x3½	5 x 8
	40	12,050	5½x11½	5½x 5½	3½x3½	5 x 5
		24,100	5½x13½	5½x 7½	3½x5½	5 x 8
1½"	16	7,240	5½x 9½	3½x 5½	3½x3½	4 x 4
		14,480	5½x13½	5½x 5½	3½x3½	5 x 5
	24	10,787	5½x11½	3½x 5½	3½x3½	4 x 5
		21,574	5½x15½	5½x 7½	3½x5½	5 x 8
	32	14,192	5½x11½	5½x 5½	3½x3½	5 x 5
		28,384	5½x15½	5½x 9½	3½x5½	5 x10
	40	17,485	5½x13½	5½x 5½	3½x3½	5 x 6
		34,970	7½x15½	5½x11½	5½x5½	7 x 9
1¾"	16	9,760	5½x11½	3½x 5½	3½x3½	4 x 5
		19,520	7½x13½	5½x 7½	3½x3½	5 x 7
	24	14,542	5½x11½	5½x 5½	3½x3½	5 x 5
		29,084	7½x15½	5½x 9½	3½x5½	5 x10
	32	19,132	5½x13½	5½x 5½	3½x3½	5 x 7
		38,264	7½x15½	7½x 9½	5½x5½	6 x11
	40	23,571	7½x13½	5½x 7½	3½x5½	5 x 8
		47,142	9½x15½	7½x11½	5½x5½	7½x11½



DOUBLE STRUT TRUSSED BEAMS

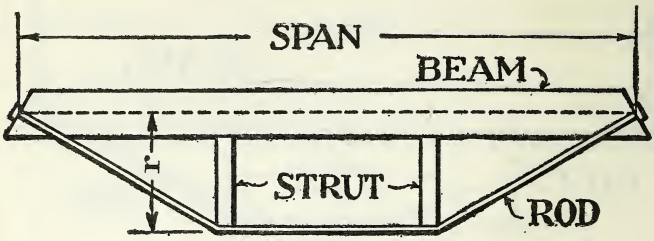
(Actual size)

SAFE LOAD IN POUNDS, UNIFORMLY DISTRIBUTED

The upper loads and timber sizes are for **one rod.**

The lower loads and timber sizes are for **two rods.**

Diam. Rod	"r" in Inches	SPAN 20 FEET				
		Load	Size of Beam	Size of Strut Without Plate	Size of Strut With Plate	Size of Bearing Plate
1"	16	4,016	3¾x 7½	3½x 3½	.....	.....
		8,032	3¾x 7½	3½x 3½	.....	.....
	24	5,890	3¾x 7½	3½x 3½	.....	.....
		11,780	3¾x 9½	3½x 3½	.....	.....
	32	7,589	3¾x 7½	3½x 3½	.....	.....
		15,178	3¾x 9½	3½x 5½	3½x3½	3½x 5
	40	9,188	3¾x 7½	3½x 3½	.....	.....
		18,376	3¾x 9½	3½x 5½	3½x3½	3½x 6
1¼"	16	6,520	3¾x 7½	3½x 3½	.....	.....
		13,040	5½x 9½	3½x 3½	.....	.....
	24	9,561	3¾x 9½	3½x 3½	.....	.....
		19,122	5½x 9½	3½x 5½	3½x3½	4 x 5
	32	12,317	3¾x 9½	3½x 3½	.....	.....
		24,634	5½x11½	5½x 5½	3½x3½	5 x 5
	40	14,913	3¾x 9½	3½x 5½	3½x3½	3½x 5
		29,826	5½x11½	5½x 5½	3½x3½	5 x 6
1½"	16	9,460	3¾x 9½	3½x 3½	.....	.....
		18,920	5½x11½	3½x 5½	3½x3½	4 x 5
	24	13,873	5½x 9½	3½x 3½	.....	.....
		27,746	5½x11½	5½x 5½	3½x3½	5 x 6
	32	17,873	5½x11½	3½x 5½	3½x3½	4 x 5
		35,746	5½x13½	5½x 7½	3½x5½	5½x 7
	40	21,640	5½x11½	5½x 5½	3½x3½	4 x 6
		43,280	5½x13½	5½x 7½	3½x5½	5½x 8½
1¾"	16	12,752	5½x 9½	3½x 3½	.....	.....
		25,504	5½x13½	5½x 5½	3½x3½	5 x 5
	24	18,702	5½x 9½	3½x 5½	3½x3½	4 x 5
		37,404	5½x13½	5½x 7½	3½x5½	5 x 8
	32	24,094	5½x11½	5½x 5½	3½x3½	5 x 5
		48,188	5½x15½	5½x 9½	3½x5½	5½x10
	40	29,172	5½x11½	5½x 5½	3½x3½	5½x 5½
		58,344	5½x15½	5½x11½	5½x5½	5½x11½



DOUBLE STRUT TRUSSED BEAMS

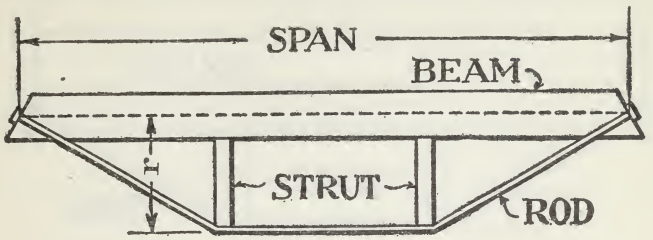
(Actual size)

SAFE LOAD IN POUNDS, UNIFORMLY DISTRIBUTED

The upper loads and timber sizes are for **one rod.**

The lower loads and timber sizes are for **two rods.**

Diam. Rod	"r" in Inches	SPAN 22 FEET				
		Load	Size of Beam	Size of Strut		Size of Bearing Plate
				Without Plate	With Plate	
1"	16	3,660	3¾x 7½	3½x 3½	.....	.....
		7,320	3¾x 7½	3½x 3½	.....	.....
	24	5,391	3¾x 7½	3½x 3½	.....	.....
		10,782	3¾x 9½	3½x 3½	.....	.....
	32	6,992	3¾x 7½	3½x 3½	.....	.....
		13,984	3¾x 9½	3½x 3½	.....	.....
	40	8,500	3¾x 7½	3½x 3½	.....	.....
		17,000	3¾x 9½	3½x 5½	3½x3½	3½x 5½
1¼"	16	5,940	3¾x 7½	3½x 3½	.....	.....
		11,880	5½x 9½	3½x 3½	.....	.....
	24	8,750	3¾x 9½	3½x 3½	.....	.....
		17,500	5½x 9½	3½x 5½	3½x3½	3½x 5½
	32	11,394	3¾x 9½	3½x 3½	.....	.....
		22,788	5½x11½	5½x 5½	3½x3½	4 x 6
	40	13,796	3¾x 9½	3½x 3½	.....	.....
		27,592	5½x11½	5½x 5½	3½x3½	5 x 6
1½"	16	8,620	5½x 9½	3½x 3½	.....	.....
		17,240	5½x11½	3½x 5½	3½x3½	4 x 5
	24	12,697	5½x 9½	3½x 3½	.....	.....
		25,394	5½x11½	5½x 5½	3½x3½	5 x 5
	32	16,468	5½x11½	3½x 5½	3½x3½	4 x 5
		32,936	5½x13½	5½x 7½	3½x5½	5 x 7
	40	20,019	5½x11½	3½x 5½	3½x3½	4 x 5
		40,038	5½x13½	5½x 7½	3½x5½	5 x 8
1¾"	16	11,620	5½x 9½	3½x 3½	.....	.....
		23,240	5½x13½	5½x 5½	3½x3½	5 x 5
	24	17,116	5½x 9½	3½x 5½	3½x3½	4 x 5
		34,232	5½x13½	5½x 7½	3½x5½	5 x 7
	32	22,200	5½x11½	5½x 5½	3½x3½	4 x 6
		44,400	5½x15½	5½x 7½	3½x5½	5½x 8
	40	27,087	5½x11½	5½x 5½	3½x3½	5 x 6
		54,174	5½x15½	5½x 9½	5½x5½	5½x10



DOUBLE STRUT TRUSSED BEAMS

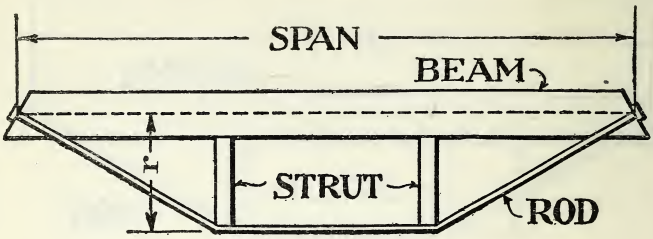
(Actual size)

SAFE LOAD IN POUNDS, UNIFORMLY DISTRIBUTED

The upper loads and timber sizes are for **one rod.**

The lower loads and timber sizes are for **two rods.**

Diam. Rod	"r" in Inches	SPAN 24 FEET				
		Load	Size of Beam	Size of Strut		Size of Bearing Plate
				Without Plate	With Plate	
1″	18	3,777	3¾x 7½	3½x 3½	.....	.....
		7,554	3¾x 7½	3½x 3½	.....	.....
	26	5,347	3¾x 7½	3½x 3½	.....	.....
		10,694	3¾x 9½	3½x 3½	.....	.....
	34	6,851	3¾x 7½	3½x 3½	.....	.....
		13,702	3¾x 9½	3½x 3½	.....	.....
	42	8,227	3¾x 7½	3½x 3½	.....	.....
		16,454	3¾x 9½	3½x 5½	3½x3½	3½x 5½
1¼″	18	6,131	3¾x 7½	3½x 3½	.....	.....
		12,262	5½x 9½	3½x 3½	.....	.....
	26	8,679	3¾x 9½	3½x 3½	.....	.....
		17,358	5½x 9½	3½x 5½	3½x3½	3½x 5½
	34	11,120	3¾x 9½	3½x 3½	.....	.....
		22,240	5½x11½	5½x 5½	3½x3½	4 x 6
	42	13,354	3¾x 9½	3½x 3½	.....	.....
		26,708	5½x11½	5½x 5½	3½x3½	5 x 6
1½″	18	8,895	5½x 9½	3½x 3½	.....	.....
		17,790	5½x11½	3½x 5½	3½x3½	4 x 5
	26	12,593	5½x 9½	3½x 3½	.....	.....
		25,186	5½x11½	5½x 5½	3½x3½	5 x 5
	34	16,136	5½x11½	3½x 5½	3½x3½	4 x 5
		32,272	5½x13½	5½x 7½	3½x5½	5 x 7
	42	19,377	5½x11½	3½x 5½	3½x3½	4 x 5
		38,754	5½x13½	5½x 7½	3½x5½	5 x 8
1¾″	18	11,991	5½x 9½	3½x 3½	.....	.....
		23,982	5½x13½	5½x 5½	3½x3½	5 x 5
	26	16,976	5½x 9½	3½x 5½	3½x3½	4 x 5
		33,142	5½x13½	5½x 7½	3½x5½	5 x 7
	34	21,752	5½x11½	5½x 5½	3½x3½	4 x 6
		43,504	5½x15½	5½x 7½	3½x5½	5½x 8
	42	26,121	5½x11½	5½x 5½	3½x3½	5 x 6
		52,242	5½x15½	5½x 9½	5½x5½	5½x10



DOUBLE STRUT TRUSSED BEAMS

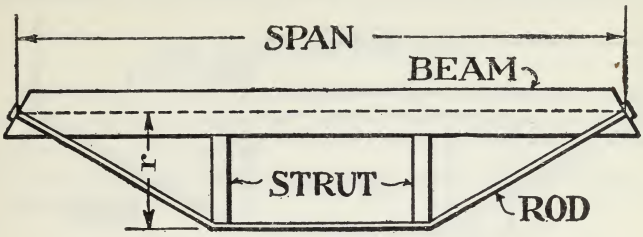
(Actual size)

SAFE LOAD IN POUNDS, UNIFORMLY DISTRIBUTED

The upper loads and timber sizes are for **one rod.**

The lower loads and timber sizes are for **two rods.**

Diam. Rod	"r" in Inches	SPAN 26 FEET				
		Load	Size of Beam	Size of Strut		Size of Bearing Plate
				Without Plate	With Plate	
1"	18	3,493	3¾x 7½	3½x 3½	.....	.....
		6,986	3¾x 9½	3½x 3½	.....	.....
	26	4,970	3¾x 7½	3½x 3½	.....	.....
		9,940	3¾x 9½	3½x 3½	.....	.....
	34	6,362	3¾x 7½	3½x 3½	.....	.....
		12,724	3¾x 9½	3½x 3½	.....	.....
	42	7,678	3¾x 7½	3½x 3½	.....	.....
		15,356	5½x 9½	3½x 5½	3½x3½	3½x 5
1¼"	18	5,670	3¾x 9½	3½x 3½	.....	.....
		11,340	5½x 9½	3½x 3½	.....	.....
	26	8,046	3¾x 9½	3½x 3½	.....	.....
		16,092	5½x11½	3½x 5½	3½x3½	4 x 5
	34	10,327	5½x 9½	3½x 3½	.....	.....
		20,654	5½x11½	5½x 5½	3½x3½	4 x 6
	42	12,463	5½x 9½	3½x 3½	.....	.....
		24,926	5½x11½	5½x 5½	3½x3½	5 x 5
1½"	18	8,227	5½x 9½	3½x 3½	.....	.....
		16,454	5½x11½	3½x 5½	3½x3½	4 x 5
	26	11,675	5½x 9½	3½x 3½	.....	.....
		23,350	5½x11½	5½x 5½	3½x3½	5 x 5
	34	14,985	5½x11½	3½x 5½	3½x3½	4 x 5
		29,970	5½x13½	5½x 5½	3½x3½	5 x 6
	42	18,084	5½x11½	3½x 5½	3½x3½	5 x 5
		36,168	5½x13½	5½x 7½	3½x5½	5 x 8
1¾"	18	11,091	5½x 9½	3½x 3½	.....	.....
		22,182	5½x13½	5½x 5½	3½x3½	4 x 6
	26	15,739	5½x11½	3½x 5½	3½x3½	4 x 5
		31,478	5½x15½	5½x 7½	3½x5½	5 x 7
	34	20,201	5½x13½	3½x 5½	3½x3½	4 x 5
		40,402	5½x15½	5½x 7½	3½x5½	5 x 8
	42	24,378	5½x11½	5½x 5½	3½x3½	5 x 5
		48,756	7½x15½	5½x 9½	3½x5½	5½x10



DOUBLE STRUT TRUSSED BEAMS

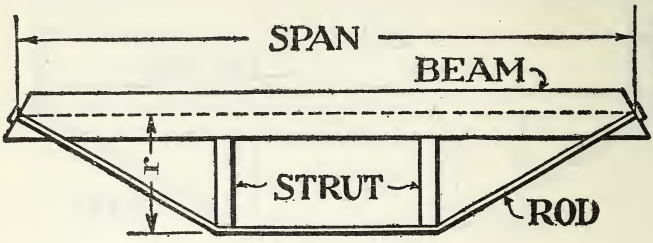
(Actual size)

SAFE LOAD IN POUNDS, UNIFORMLY DISTRIBUTED

The upper loads and timber sizes are for **one rod.**

The lower loads and timber sizes are for **two rods.**

Diam. Rod	"r" in Inches	SPAN 28 FEET				
		Load	Size of Beam	Size of Strut Without Plate	Size of Strut With Plate	Size of Bearing Plate
1″	18	3,250	3¾x 9½	3½x 3½	.....	.....
		6,500	3¾x 9½	3½x 3½	.....	.....
	26	4,626	3¾x 9½	3½x 3½	.....	.....
		9,252	3¾x 9½	3½x 3½	.....	.....
	34	5,958	3¾x 9½	3½x 3½	.....	.....
		11,916	3¾x 9½	3½x 3½	.....	.....
	42	7,217	3¾x 9½	3½x 3½	.....	.....
		14,434	5½x 9½	3½x 5½	3½x3½	3½x 5
1¼″	18	5,275	3¾x 9½	3½x 3½	.....	.....
		10,550	5½x 9½	3½x 3½	.....	.....
	26	7,509	3¾x 9½	3½x 3½	.....	.....
		15,018	5½x11½	3½x 5½	3½x3½	4 x 5
	34	9,671	5½x 9½	3½x 3½	.....	.....
		19,342	5½x11½	3½x 5½	3½x3½	4 x 5
	42	11,714	5½x 9½	3½x 3½	.....	.....
		23,428	5½x11½	5½x 5½	3½x3½	5 x 5
1½″	18	7,654	5½x 9½	3½x 3½	.....	.....
		15,308	5½x11½	3½x 5½	3½x3½	4 x 5
	26	10,895	5½x 9½	3½x 3½	.....	.....
		21,790	5½x11½	5½x 5½	3½x3½	4 x 6
	34	14,033	5½x11½	3½x 5½	3½x3½	4 x 4
		28,066	5½x13½	5½x 5½	3½x3½	5 x 6
	42	16,998	5½x11½	3½x 5½	3½x3½	4 x 5
		33,996	5½x13½	5½x 7½	3½x5½	5 x 7
1¾″	18	10,318	5½x 9½	3½x 3½	.....	.....
		20,636	5½x13½	3½x 5½	3½x3½	4 x 5
	26	14,687	5½x11½	3½x 5½	3½x3½	4 x 4
		29,374	5½x15½	5½x 5½	3½x3½	5½x 5½
	34	18,917	5½x11½	3½x 5½	3½x3½	4 x 5
		37,834	5½x15½	5½x 7½	3½x5½	5 x 8
	42	22,914	5½x11½	5½x 5½	3½x3½	4 x 6
		45,828	7½x15½	5½x 9½	3½x5½	5½x10



DOUBLE STRUT TRUSSED BEAMS

(Actual size)

SAFE LOAD IN POUNDS, UNIFORMLY DISTRIBUTED

The upper loads and timber sizes are for **one rod.**

The lower loads and timber sizes are for **two rods.**

Diam. Rod	"r" in Inches	SPAN 30 FEET				
		Load	Size of Beam	Size of Strut		Size of Bearing Plate
				Without Plate	With Plate	
1"	18	3,039	3¾x 9½	3½x 3½	.....	.....
		6,078	3¾x 9½	3½x 3½	.....	.....
	26	4,333	3¾x 9½	3½x 3½	.....	.....
		8,666	3¾x 9½	3½x 3½	.....	.....
	34	5,581	3¾x 9½	3½x 3½	.....	.....
		11,162	3¾x 9½	3½x 3½	.....	.....
	42	6,781	3¾x 9½	3½x 3½	.....	.....
		13,562	5½x 9½	3½x 3½	.....	.....
1¼"	18	4,935	3¾x 9½	3½x 3½	.....	.....
		9,870	5½x 9½	3½x 3½	.....	.....
	26	7,033	3¾x 9½	3½x 3½	.....	.....
		14,066	5½x11½	3½x 5½	3½x3½	4 x 4
	34	9,059	5½x 9½	3½x 3½	.....	.....
		18,118	5½x11½	3½x 5½	3½x3½	4 x 5
	42	11,118	5½x 9½	3½x 3½	.....	.....
		22,236	5½x11½	5½x 5½	3½x3½	4 x 6
1½"	18	7,158	5½x 9½	3½x 3½	.....	.....
		14,316	5½x11½	3½x 5½	3½x3½	4 x 4
	26	10,206	5½x 9½	3½x 3½	.....	.....
		20,412	5½x11½	3½x 5½	3½x3½	4 x 5
	34	13,145	5½x11½	3½x 3½	.....	.....
		26,290	5½x13½	5½x 5½	3½x3½	4 x 5
	42	15,972	5½x11½	3½x 5½	3½x3½	4 x 5
		31,944	5½x13½	5½x 7½	3½x5½	5 x 7
1¾"	18	9,650	5½x 9½	3½x 3½	.....	.....
		19,300	5½x13½	3½x 5½	3½x3½	4 x 5
	26	13,758	5½x11½	3½x 3½	.....	.....
		27,516	5½x15½	5½x 5½	3½x3½	5 x 6
	34	17,720	5½x13½	3½x 5½	3½x3½	4 x 5
		35,440	5½x15½	5½x 7½	3½x5½	5 x 7
	42	21,531	5½x11½	5½x 5½	3½x3½	4 x 6
		43,062	7½x15½	5½x 7½	3½x5½	5½x 8

JOIST CONSTRUCTION

The following table pertaining to joist construction gives the board feet and weight per square foot including the usual range of such constructions.

For total weight of floor or roof constructions add weights as follows:

Weights in Pounds per Square Foot	
Yellow Pine Sheathing	2.75
Yellow Pine Flooring	2.75
Wooden Shingles	2.00
Painted Tin	2.00
Painted Sheet Metal	3.00
Corrugated Sheet Metal	4.00
Composition Roofing	9.00
Slate, 1/8″ thick	4.50
Slate, 3/16″ thick	6.75
Slate, 1/4″ thick	10.00
Tiles, Flat	18.00
Tiles, Spanish	8.50
Tiles, Ludowici	8.00
Plastering and Lath	6-8

For weights of other roofing materials, see page 91.

The following percentages should be added to estimates to cover scant widths only, the waste for length varies according to circumstances and is not given here.

Fencing, S1S1E.		
No. 1 Common,	3″ wide	9.09%
	4″ "	6.66%
	5″ "	5.26%
	6″ "	4.35%
No. 2 Common,	3″ "	20.00%
	4″ "	14.30%
	5″ "	11.11%
	6″ "	9.09%
Common Boards, S1S1E.		
No. 1 Common,	8″ wide	3.22%
	9″ "	4.34%
	10″ "	3.89%
	11″ "	4.76%
	12″ "	4.35%
No. 2 Common,	8″ "	6.66%
	9″ "	7.46%
	10″ "	6.66%
	11″ "	7.31%
	12″ "	6.66%
Matched and Dressed Flooring.		
	1x3, 2 1/4″ face	33.33%
	1x4, 3 1/4″ "	23.08%
	1x6, 5 1/4″ "	14.28%
Heavy Mill Flooring, Matched and Dressed.		
	2x6 to 6x6, 5 1/8″ face	17.07%
Heavy Mill Flooring, grooved for Splines.		
	2x6 to 6x6, 5 1/2″ face	9.09%

WEIGHT AND BOARD MEASURE OF JOIST CONSTRUCTION

Board measure based on nominal size.
Weight based on actual size.
Add weight of ceiling, floor and roof finish.

Nominal Size	Actual Size	Distance on Centers Inches	Per Square Foot of Surface		
			Lineal Feet of Joist	Board Feet	Weight Pounds
2 x 4	1⅝x 3⅝	12	1.00	.66	1.63
"	"	16	.75	.50	1.22
"	"	20	.60	.40	.98
2 x 6	1⅝x 5⅝	12	1.00	1.00	2.53
"	"	16	.75	.75	1.89
"	"	20	.60	.60	1.52
2 x 8	1⅝x 7½	12	1.00	1.33	3.38
"	"	16	.75	1.00	2.53
"	"	20	.60	.80	2.03
"	"	24	.50	.66	1.70
2 x10	1⅝x 9½	12	1.00	1.66	4.28
"	"	16	.75	1.25	3.21
"	"	18	.66	1.11	2.85
"	"	20	.60	1.00	2.57
"	"	24	.50	.833	2.14
2 x12	1⅝x11½	12	1.00	2.00	5.18
"	"	16	.75	1.50	3.88
2½x12	2¼x11½	12	1.00	2.50	7.17
"	"	16	.75	1.875	5.38
3 x12	2¾x11½	12	1.00	3.00	8.76
"	"	16	.75	2.25	6.57
2 x14	1¾x13½	12	1.00	2.33	6.55
"	"	14	.857	1.997	5.61
"	"	16	.75	1.75	4.91
2½x14	2¼x13½	12	1.00	2.917	8.41
"	"	14	.857	2.50	7.21
"	"	16	.75	2.187	6.30
3 x14	2¾x13½	12	1.00	3.50	10.28
"	"	14	.857	3.00	8.81
"	"	16	.75	2.625	7.71
2 x16	1¾x15½	12	1.00	2.66	7.51
"	"	14	.857	2.285	6.43
"	"	16	.75	2.00	5.63
2½x16	2¼x15½	12	1.00	3.33	9.66
"	"	14	.857	2.857	8.28
"	"	16	.75	2.50	7.25
3 x16	2¾x15½	12	1.00	4.00	11.81
"	"	14	.857	3.428	10.12
"	"	16	.75	3.00	8.857
4 x16	3¾x15½	12	1.00	5.33	16.10
"	"	14	.857	4.57	13.80
"	"	16	.75	4.00	12.07

Combined Roof Loads

(Carnegie Steel Co., Pocket Companion, 21st Edition)

COMBINED ROOF LOADS. In climates corresponding to that of Pittsburgh, and where the roof loads are not fixed by building laws, ordinary roofs up to 80 feet span should carry the following minimum loads per square foot of exposed surface, applied vertically, to provide for dead, wind and snow loads combined.

Roof Covering	Roof Load per Square Foot, Pounds
Gravel or Composition Roofing — on boards, flat slope, 1 to 6 or less	50
Gravel or Composition Roofing — on boards, steep slope, more than 1 to 6	45
Gravel or Composition Roofing — on 3 inch flat tile or cinder concrete	60
Corrugated sheeting on boards or purlins	40
Slate — on boards or purlins	50
Slate — on 3 inch flat tile or cinder concrete	65
Tile on steel purlins	55
Glass	45

For roofs in climates where no snow is likely to occur, reduce these loads by 10 pounds per square foot, but no roof or any part thereof should be designed for a total live and dead load less than 40 pounds per square foot.

Approximate Weight of Roofing Material

Roofing Material	Weight per Square Foot, Pounds
Copper, No. 22 B. W. G	1 1/4
Corrugated galvanized iron, No. 20 B. W. G	2 1/4
Corrugated galvanized iron, No. 26 B. W. G	1 1/4
Felt, 2 layers	1/2
Felt and asphalt or coal-tar	2
Glass, 1/8 inch thick	1 3/4
Lath and plaster ceiling	6–8
Lead, 1/8 inch thick	7 1/2
Mackite, 1 inch thick, with plaster	10
Sheathing, hemlock, 1 inch thick	2
Sheathing, white pine, spruce, 1 inch thick	2 1/4–2 1/2
Sheathing, yellow pine, 1 inch thick	3 1/2
Shingles, 6x18 inches, 6 inches to weather	2
Skylight, glass 3/16 to 1/2 inch, including frame	4–10
Slag roof, 4-ply, with cement and sand	4
Slate, 1/8 inch thick, 3 inch double lap	4 1/2
Slate, 3/16 inch thick, 3 inch double lap	6 3/4
Terneplate, IC	5/8
Terneplate, IX	1/2
Tiles (plain), 10 1/2x6 1/4x 5/8 in., 5 1/4 inches to weather	18
Tiles (Spanish), 14 1/2x10 1/2 in., 7 1/4 inches to weather	8 1/2
Zinc, No. 20 B. W. G	1 1/2

FLOORS AND ROOFS

(Carnegie Steel Co., Pocket Companion, 21st Edition)

MINIMUM LIVE LOADS, POUNDS PER SQUARE FOOT
By Building Laws of Various Cities

Kind of Building	Baltimore, 1908	Boston, 1912	Chicago, 1911	Cleveland, 1911	New York, 1916	Philadelphia, 1913	Pittsburgh, 1914	St. Louis, 1910	San Francisco, 1910
Apartment Houses, etc.:									
Floors	60	50	40	50	40	70	50	60	60
Hospitals, Asylums:									
Floors	.....	.....	50	60	.....	70	70	.....	60
Assembly Rooms, etc.	.....	.....	100	80	.....	120	125	.....	125
Hotels:									
Floors	60	50	50	50	40	70	70	60	60
Assembly Rooms, etc.	125	100	100	80	100	120	125	100	75
Factories:									
Floors, light manufacture	125a	125a	100a	125a	120a	120a	125a	150a	125a
Floors, heavier	175a	.....	.....	200a	.....	150a	.....	.....	250a
Mercantile Buildings:									
Stores, light goods	125	125	100	100b	120	120	125	150	125
Stores, heavier goods	175	250	.....	200	.....	150	200	150	250
Warehouse floors	250	250	.....	200	.....	150	200	150	250
Office Buildings:									
Floors	75	100	50	60	60	100	70	70	60
Assembly Rooms, etc.	125	125	100	100	100	120	125	100	125
Public Assembly Halls:									
Auditoriums, fixed seats	75	125	100	80	100	120	125	100	75
Auditoriums, movable seats	125	125	100	100	100	120	125	100	125
Churches	75	125	100	80	100	120	125	100	75
Dance and Drill Halls	.....	200	100	150	.....	.....	150	.....	.....
Theatres	75	125	100	80	100	120	125	100	75
Schools:									
Class Rooms	75	60	40	60	75	70	70	100	75
Assembly Rooms, etc.	75	125	75	80	100	120	125	100	125
Sidewalks	200	.....	.....	200	300	.....	.....	.....	150
Stables, Garages, etc.	100	.....	100	80	.....	.....	125	.....	75
Stairways, Fire Escapes	.....	70	100	80	.....	.....	.....	.....	.....
Roofs:									
Flat, slope under 20°	40	40	25	40	40	30	50c	40	30
Steep, slope over 20°	20	.....	25d	40d	30	30d	50c	.....	20
Wind Pressure	30	.....	20	30e	30	30e	25	30	20

a Floor loads do not include weight or impact load of machinery.
b Ground or First Floor: Baltimore 150, Cleveland 125, St. Louis 150 pounds.
c Dead and live load; snow load 25 pounds, reduced 1 pound for each degree between 20° and 45°.
d Load per square foot of superficial roof area; other roof loads are for the projected area.
e Wind pressure for high buildings in built-up districts 35 pounds; buildings 14 stories high or over: 25 pounds at tenth story, 2½ pounds less each story below.

SAFE SPANS FOR JOISTS
(Actual size)

An extreme fibre stress of 1800 pounds per square inch is the basis of the two graphic tables on pages 94 and 95.

To use for other stresses:

f = extreme fibre stress in pounds per square inch.
load = total load per square foot of floor surface.

for f = 1000. Given load × 1.8 = new load.
for f = 1200. Given load × 1.5 = new load.
for f = 1300. Given load × 1.4 = new load.
for f = 1400. Given load × 1.3 = new load.
for f = 1440. Given load × 1.25 = new load.
for f = 1500. Given load × 1.2 = new load.
for f = 1600. Given load × 1.13 = new load.
for f = 1700. Given load × 1.06 = new load.

To use for other spacings center to center.

for 18″ c to c, multiply load per square foot by 1½ and use loads for 12″ spacing.
for 20″ c to c, multiply load per square foot by 1⅔ and use loads for 12″ spacing.
for 24″ c to c, multiply load per square foot by 2 and use loads for 12″ spacing.

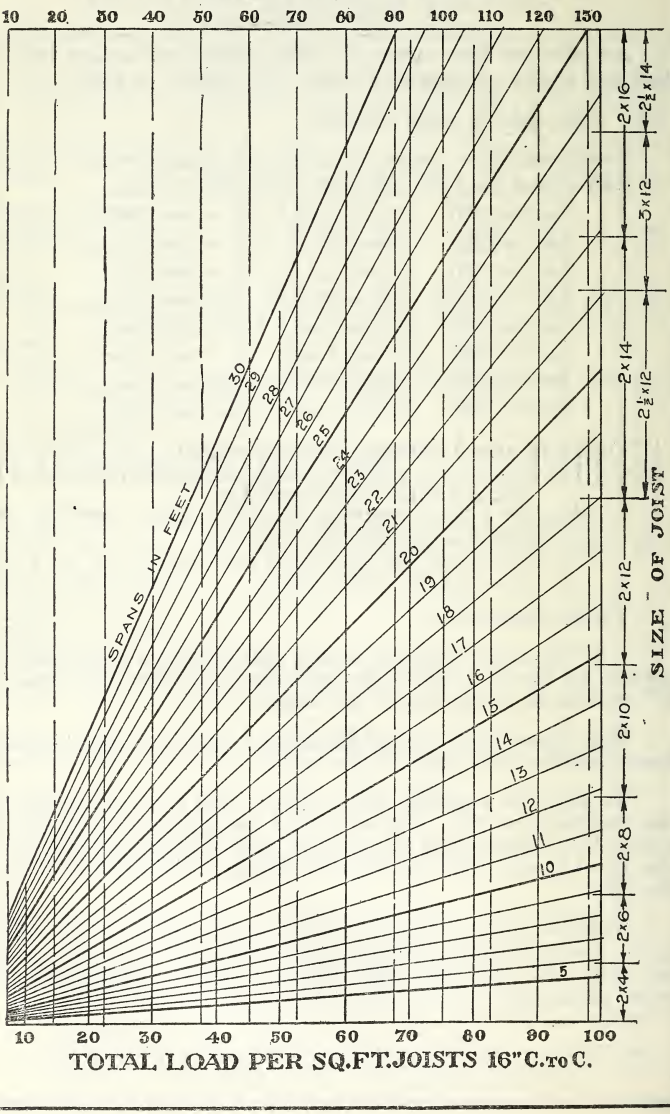
To use the tables.

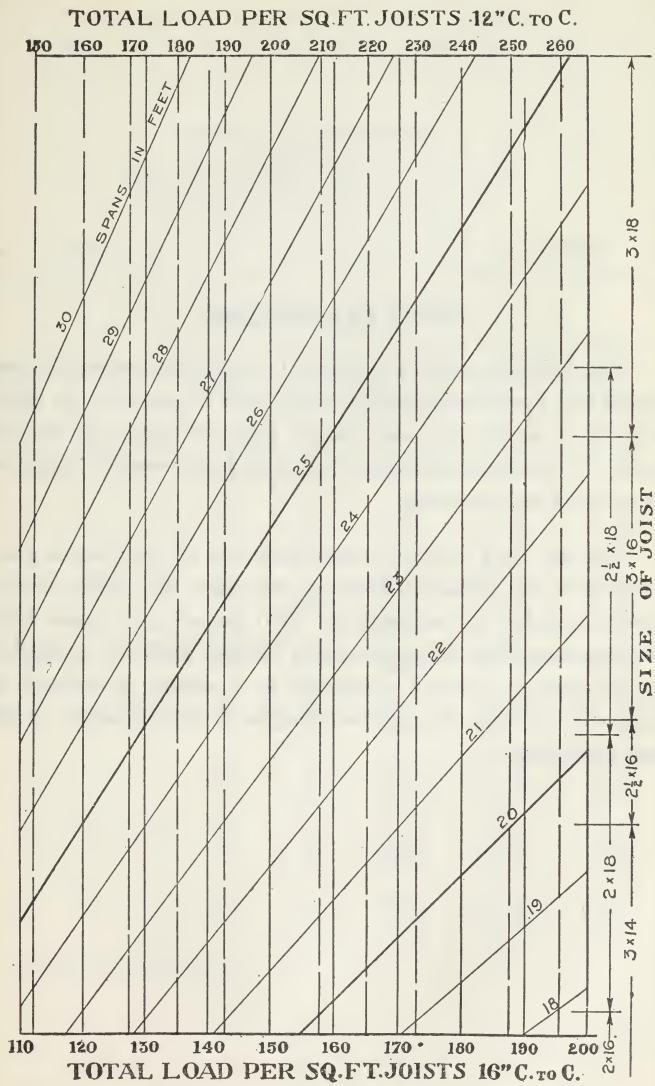
The total loads per square foot for joists spaced 16″ on centers are found at the bottom of the table, for joists spaced 12″ on centers at the top of the table.

The spans in feet are indicated by inclined lines and the size of joists at the right of the table.

To find the required size of joists, find the intersection of the vertical line from the total load per square foot with the incline line representing the span in feet; a horizontal line from this point to the right of the table will give the required size of the joist.

NOTE.—For deflection of joists see pages 16 to 35, inclusive. For safe loads limited by resistance to horizontal shear see page 36. For the dead weight of joist construction see pages 89 and 90.


TOTAL LOAD PER SQ.FT. JOISTS 12" C. TO C.
10 20 30 40 50 60 70 80 90 100 110 120 130
SPANS IN FEET
30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 5
SIZE OF JOIST
2x16
2½x14
3x12
2x14
2½x12
2x12
2x10
2x8
2x6
2x4
10 20 30 40 50 60 70 80 90 100
TOTAL LOAD PER SQ.FT. JOISTS 16" C. TO C.


TOTAL LOAD PER SQ.FT. JOISTS 12" C. TO C.
150 160 170 180 190 200 210 220 230 240 250 260
SPANS IN FEET
30
29
28
27
26
25
24
23
22
21
20
19
18
3×18
2½×18
3×16
2½×16
2×18
3×14
2×16
SIZE OF JOIST
110 120 130 140 150 160 170 180 190 200
TOTAL LOAD PER SQ.FT. JOISTS 16" C. TO C.

STUD PARTITIONS.

The following table pertaining to stud partitions gives the weight and board measure per lineal foot of partition in plan, including a single top and bottom plate of same size as the studs. To these weights should be added the weight of plastering or other wall covering.

The safe load in pounds per lineal foot of partition in plan is based on the Winslow Formula, see page 48, using a compression parallel to the grain of 1000 pounds per square inch and assuming that the partition is bridged midway in height. By this means the stud considered as a column is reduced in height to one-half the partition height in the direction of its least dimension.

STUD PARTITIONS

Weight and strength based on actual size.

Board measure based on nominal size.

Add weight of plaster or ceiling.

Single plate top and bottom included, same size as studs.

SAFE LOAD BASED ON STUDS BEING BRIDGED AT CENTER

For formula and stress see pages 48 and 96.

Nominal Size	Actual Size	Distance on Centers Inches	Height	Per Lineal Foot of Partition		
			Feet	Safe Load Pounds	Weight, Pounds	Board Feet
2 " x 4	1⅝ x 3⅝	12	8	3723	16.30	6.66
"	"	"	10	3180	19.56	8.00
"	"	"	12	2631	22.82	9.33
"	"	16	8	2793	13.04	5.33
"	"	"	10	2385	15.50	6.33
"	"	"	12	1974	18.00	7.33
2 x 6	1⅝ x 5⅝	12	8	5767	25.30	10.00
"	"	"	10	4926	30.56	12.00
"	"	"	12	4076	35.42	14.00
"	"	16	8	4326	20.24	8.00
"	"	"	10	3699	24.03	9.50
"	"	"	12	3057	27.83	11.00
2½ x 6	2¼ x 5½	12	8	9079	34.30	12.50
"	"	"	10	8250	41.16	15.00
"	"	"	12	7422	48.02	17.50
"	"	16	8	6808	27.44	10.00
"	"	"	10	6187	32.59	12.00
"	"	"	12	5566	37.73	13.75
3 x 6	2¾ x 5½	12	8	11823	42.00	15.00
"	"	"	10	10992	50.40	18.00
"	"	"	12	10175	58.80	21.00
"	"	16	8	8868	33.60	12.00
"	"	"	10	8244	39.90	14.25
"	"	"	12	7630	46.20	16.50

Concluded on next page.

STUD PARTITIONS

Weight and strength based on actual size.

Board measure based on nominal size.

Add weight of plaster or ceiling.

Single plate top and bottom included, same size as studs.

SAFE LOAD BASED ON STUDS BEING BRIDGED AT CENTER.

For formula and stress see pages 48 and 96.

Nominal Size	Actual Size	Distance on Centers Inches	Height Feet	Per Lineal Foot of Partition		
				Safe Load Pounds	Weight Pounds	Board Feet
2 x 8	1⅝x 7½	12	8	7692	33.80	13.33
"	"	"	10	6570	40.56	16.00
"	"	"	12	5436	47.32	18.66
"	"	"	14	4315	54.08	21.33
"	"	16	8	5769	27.04	10.66
"	"	"	10	4927	32.11	12.66
"	"	"	12	4077	37.18	14.66
"	"	"	14	3236	42.25	16.66
2½x 8	2¼x 7½	12	8	12382	46.80	16.66
"	"	"	10	11252	56.16	20.00
"	"	"	12	10122	65.52	23.33
"	"	"	14	9008	74.88	26.66
"	"	16	8	9286	37.44	13.33
"	"	"	10	8439	44.46	15.83
"	"	"	12	7591	51.48	18.33
"	"	"	14	6756	58.50	20.83
3 x 8	2¾x 7½	12	8	16124	57.20	20.00
"	"	"	10	14990	68.64	24.00
"	"	"	12	13877	80.08	28.00
"	"	"	14	12743	91.52	32.00
"	"	16	8	12093	45.76	16.00
"	"	"	10	11242	54.34	19.00
"	"	"	12	10408	62.92	22.00
"	"	"	14	9557	71.50	25.00

Continued from page 97.

WEIGHT OF WOODEN TRUSSES

In designing roof trusses it is necessary to assume the dead weight of the truss to be included with other loads upon which the designing is based.

The most comprehensive investigation of this matter is that made by N. Clifford Ricker, the results of which are given in his treatise entitled DESIGN AND CONSTRUCTION OF ROOFS (John Wiley & Sons, 1912), from which is quoted as follows:

> "The weight of the truss varies with its span and rise, with the distance between centers of adjacent trusses, and further with the intensity of the snow and wind loads, that must be supported by the roof.
>
> The formula here given results from the careful designing and calculation of the actual weights of a large number of trusses of longleaf pine and steel rods, for spans increasing from 20 to 200 feet, for rises from 1/10 to 1/4 the span, and for distances between centre planes of trusses increasing from 10 to 30 feet. It may therefore be assumed to approximate the actual weights of roof trusses within the given limits, required to safely support the sum of permanent, snow and wind loads on the roof.
>
> The weight of the truss is given in pounds per square foot of the area of the horizontal projection of that portion of the roof supported by one truss."
>
> $w = \text{span}/25 + \text{span}^2/6200.$

HOLDING POWER OF NAILS AND SPIKES

From Bulletin No. 11, Vol. IV, Engineering Experiment Station, Iowa State College, concerning the holding power of nails in single shear is quoted:

> "Three blocks of Yellow Pine ranging from 12″ to 15″ in length were nailed together with center piece projecting one-fourth its length beyond the outside pieces. The outer pieces were of such thickness as to correspond to the thickness used in actual practice for the particular size of nail used. The same number of nails were used on each side of the joint and when tested in compression a true shear was obtained without tension or bending moment due to eccentricity."

Common Wire Nails in Single Shear.

Average strength in pounds per nail.

8d, 2½″ long,	10¼	gauge.....	294
10d, 3″ long,	9	gauge.....	324
12d, 3¼″ long,	9	gauge.....	625
16d, 3½″ long,	8	gauge.....	494

20d, 4″	long,	6	gauge..... 746
30d, 4½″	long,	5	gauge..... 1221
40d, 5″	long,	4	gauge..... 1067
50d, 5½″	long,	3	gauge..... 1425
60d, 6″	long,	2	gauge..... 1783

From tests made at Purdue University by H. D. Darrow and D. W. Buchanan in 1898-99 is quoted:

Lateral resistance of nails.
Driven in Yellow Pine,
(Expressed in pounds)

4d common	213
6d common	317
8d common	427
10d common	932
16d common	1079
20d common	1112
40d common	1360

The joint will slip at about 60% of the above loads and the safe load should be based on the yield point rather than the ultimate strength. It was also found that a slip of 1/16 inch corresponded to the yield point.

From the Transactions American Society of Mechanical Engineers, 1895, Vol. 16, page 1002, by R. C. Carpenter is quoted:

Pulling nails driven in Yellow Pine.
Maximum load in pounds at start in pulling.

20d wire, 3.5″ penetration	318
10d wire, 3.0″ penetration	214
8d wire, 2.25″ penetration	167
6d wire, 1.75″ penetration	88

The relative holding power of wire nails driven in Yellow Pine parallel to the grain and perpendicular to the grain is as 1 is to 1.27.

(Tests of Metals, Watertown Arsenal, 1884, page 448.)

From tests made by J. B. Tscharner at the University of Illinois, published in Engineering News, Feb. 28, 1891 is quoted:

Ultimate holding power per linear inch
of 1-inch round drift bolts.
(Driven in Yellow Pine)

Diameter of hole 15/16 inch	375 pounds
Diameter of hole 7/8 inch	633 pounds
Diameter of hole 13/16 inch	788 pounds
Diameter of hole 3/4 inch	400 pounds

The maximum resistance is obtained when the diameter of the hole is about 80% of that of the bolt. The holding power of drift bolts driven perpendicular to the grain is approximately double that when driven

parallel to the grain. When a drift bolt driven 6 inches into the timber is withdrawn 1 inch only 20% of its initial resistance remains.

From tests made on the holding power of wood screws by N. M. Works and W. J. Graves at Cornell University in 1897-98 and published in the Transaction Association of Civil Engineers of Cornell University, 1898, Vol. 6, page 63; and 1900, Vol. 8, page 113, is quoted:

Ultimate holding power of wood screws per inch of total length.
Inserted in Yellow Pine perpendicular to the grain.

Gauge No.	4	8	12	16	20	24	28
Pounds	295	400	505	547	618	675	732

Example: The holding power of a No. 20 screw, 3 inches long is 3x618=1854 pounds ultimate.
Driving the screws part way with a hammer lessens the holding power. The effective length of the threaded portion of the screw excludes from 3 turns for No. 4 to 1½ turns for No. 28 to allow for tapering ends. The average ratio of the holding power for screws parallel to the grain, to that perpendicular to the grain is 77%. In Yellow Pine the holding power of screws in sap wood is less than in heart wood, the difference being 30% or more. Since the elastic limit of timber is about 75% of its ultimate strength, a relatively low ratio between the ultimate and safe loading power for screws may be adopted provided the number of screws used in the connection is not too small.

Much of the foregoing data pertaining to the weight of wood trusses and the holding power of nails, spikes and screws is taken from DESIGN OF HEAVY FRAMING by Henry S. Jacoby, Professor of Bridge Engineering in Cornell University (John Wiley & Sons, 1910) and DESIGN AND CONSTRUCTION OF ROOFS by N. Clifford Ricker, Professor of Architecture, University of Illinois (John Wiley & Sons, 1912); in which books complete information concerning the subjects indicated is found.

CREOSOTED WOOD BLOCK FLOORS

On account of the great popularity of Creosoted Pine Blocks as a flooring material, we feel that a plan showing the usual methods of laying these floors will be useful to Engineers and Architects.

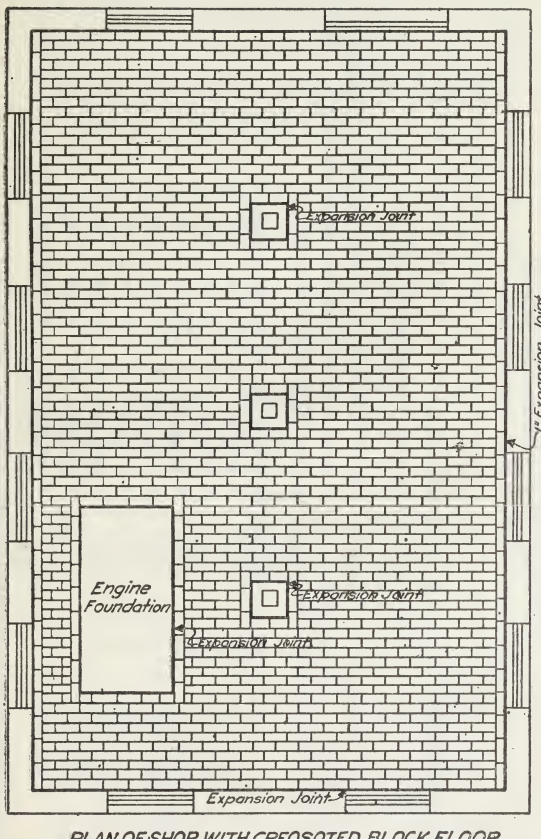
This type of floor can be found in machine shops, roundhouses, loading platforms, foundries, warehouses, ferry boats, printing establishments, laundries, bakeries, stables, barns, garages, chicken houses, and for driveways through large buildings, piers, docks, etc.

The material is sanitary, antiseptic, noiseless, dustless, and easy to take up and replace around foundations, and where new machinery is being installed. It is very durable under all conditions, and, in fact, stands wear and tear better than any other material. It is easy on the feet of men and animals. There is no grit from it to damage bearings of machinery, and damage to tools and castings, when dropped on the floor, is reduced to a minimum.

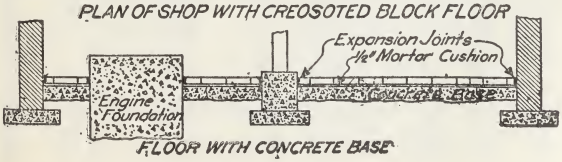
In general, the specifications for treating and laying do not vary materially from street paving specifications, but the conditions should be met in each floor as they appear. A strictly dry floor should have a lighter and different treatment than one subjected to constant washing and wetting.

The blocks should preferably be laid on a concrete foundation, but where this is impractical a creosoted shiplap pine subfloor may be laid.

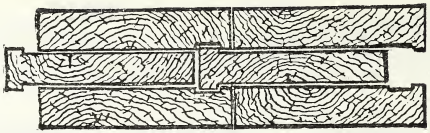
SHOP FLOOR
CONSTRUCTED OF CREOSOTED PINE BLOCKS



PLAN OF SHOP WITH CREOSOTED BLOCK FLOOR



FLOOR WITH CONCRETE BASE



(Protected by Patent and Patent Application)

"THE STANDARD" MARTINEZ INTERLOCK WOOD SHEET-PILING

Safety Tables for Estimating

Special Note: The units of the MARTINEZ INTERLOCK WOOD SHEET-PILING are made up of three separate pieces. The tongue or center piece is dressed on two sides and edges. The outside or grooved pieces are dressed on the two edges and on ONE SIDE ONLY.

A finished size unit 3 ″x5½″ is the equivalent of 4″x 6″ B. M. in the rough.

"	"	"	"	4½″x5½″	"	"	"	"	6″x 6″	"	"	"	"
"	"	"	"	4½″x7½″	"	"	"	"	6″x 8″	"	"	"	"
"	"	"	"	4½″x9½″	"	"	"	"	6″x10″	"	"	"	"
"	"	"	"	5¾″x7½″	"	"	"	"	7″x 8″	"	"	"	"
"	"	"	"	5¾″x9½″	"	"	"	"	7″x10″	"	"	"	"
"	"	"	"	6¾″x7½″	"	"	"	"	8″x 8″	"	"	"	"
"	"	"	"	6¾″x9½″	"	"	"	"	8″x10″	"	"	"	"
"	"	"	"	7¾″x9½″	"	"	"	"	9″x10″	"	"	"	"

Larger and special sizes are manufactured where conditions require it.

The feet B. M. for any construction is easily obtained from the following table:

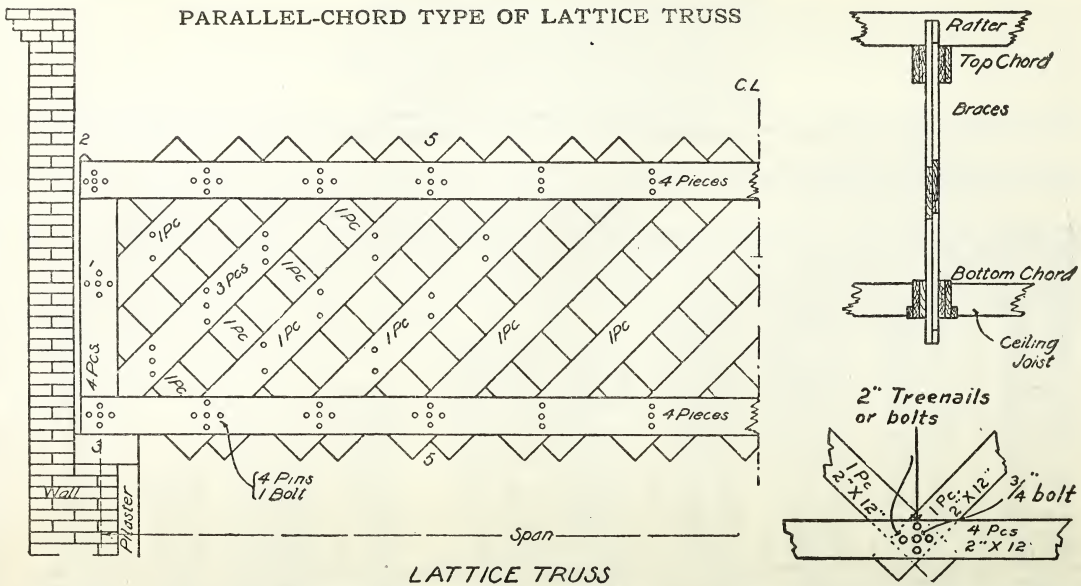
UNITS IN THE ROUGH

Length	4x6	6x6	6x8	6x10	7x8	7x10	8x8	8x10	9x10
10	43.63	65.45	64.	63.15	74.66	73.67	85.33	84.2	94.73
12	52.36	78.54	76.8	75.78	89.6	88.4	102.39	101.04	113.67
14	61.09	91.63	89.6	88.41	104.51	103.13	119.46	117.88	132.62
16	69.82	104.72	102.4	101.04	119.44	117.87	136.52	134.72	151.53
18	78.55	117.81	115.2	113.67	134.38	132.61	153.59	151.56	170.50
20	87.28	130.90	128.	126.3	149.31	147.34	170.65	168.4	189.46
22			140.8	138.94	164.24	162.08	187.72	185.24	208.4
24			153.6	151.57	179.17	176.82	204.78	202.08	227.35
26			166.4	164.2	194.1	101.55	221.85	218.92	246.29
28			179.2	176.83	209.03	206.29	238.92	235.76	265.29
30			192.	189.46	223.96	221.02	255.98	252.6	284.19
32				202.09	238.89	235.76	273.05	269.44	303.13
34				214.72	253.82	250.5	290.12	286.28	322.08
36						265.23	307.18	303.12	341.02
38						279.97	324.25	319.96	359.97
40						294.70	342.32	336.8	378.92

Quantity of Lumber Required.—After deciding upon the length and the thickness of the unit to be used, multiply the linear feet of the contemplated construction by the figures found under the unit selected in the column under Units In The Rough and directly opposite the length desired, and point off. This will give the number of feet Board Measure in such construction.

Number of Units To Be Driven.—The number of units to be driven is found by reducing the linear feet of the construction to inches, and dividing the result by the net width of the unit desired.

Linear Feet of Construction.—The total number of linear feet in any piece of construction may be found by multiplying the number of units by the length of the unit.


PARALLEL-CHORD TYPE OF LATTICE TRUSS
C.L
2
5
4 Pieces
1 Pc
3 Pcs
1 Pc
1 Pc
1 Pc
1 Pc
1 Pc
1 Pc
1 Pc
1 Pc
1
4 Pcs
4 Pieces
5
5
4 Pins
1 Bolt
Wall
Plaster
Span
LATTICE TRUSS
Rafter
Top Chord
Braces
Bottom Chord
Ceiling Joist
2" Treenails or bolts
1 Pc 2" X 12"
1 Pc 2" X 12"
3/4" bolt
4 Pcs 2" X 12"
Lower Joint 5

DIMENSIONS FOR LATTICE TRUSS

UNIFORM LOAD 40 LBS. PER SQUARE FOOT

Span	Spacing of Trusses	Height—out to out of Chords		No. of Spaces	No. and Size of Pieces of Bottom Chord	No. and Size of Pieces of Top Chord	Size of Braces	No. and Diameter of Bolts or Treenails Joints 1–5
Feet	Feet	Feet	Ins.					
	12	5	6	16	4–2x 6	4–2x 6	2x 6	4–1″
		7	2	12	4–2x 6	4–2x 6	2x 6	4–1″
40	14	5	7	16	4–2x 6	4–2x 8	2x 6	4–1″
		7	3	12	4–2x 6	4–2x 8	2x 6	4–1″
	16	5	8	16	4–2x 8	4–2x 8	2x 8	4–1 1/4″
		7	4	12	4–2x 8	4–2x 8	2x 8	4–1 1/4″
	12	8	4	16	4–2x10	4–2x10	2x10	4–1 3/4″
		10	10	12	4–2x10	4–2x10	2x10	4–1 3/4″
	14	8	4	16	4–2x10	4–2x10	2x10	4–1 3/4″
60		10	10	12	4–2x10	4–2x10	2x10	4–1 3/4″
	16	8	4	16	4–2x10	4–2x10	2x10	4–1 3/4″
		10	10	12	4–2x10	4–2x10	2x10	4–1 3/4″
	14	11	0	16	4–2x12	4–2x12	2x12	4–2″
		14	0	12	4–2x12	4–2x12	2x12	4–2″
80	16	11	2	16	4–2x14	4–2x14	2x12	4–2″
		14	0	12	4–2x12	4–2x12	2x12	4–2″
	18	11	2	16	4–2x14	4–2x14	2x12	4–2″
		14	1	12	4–2x12	4–2x14	2x12	4–2″

FILL ALL JOINT SPACES WITH PACKING BLOCKS. WHERE TREENAILS ARE USED IN JOINTS, ADD ONE 3/4″ BOLT IN CENTER OF JOINT.

SHORT CUTS IN THE DESIGN OF ROOF HOWE TRUSSES

BY BENJAMIN E. WINSLOW, MEM. AM. SOC. C. E., MEM. A. I. A.
(All rights reserved)

This paper shows the result of an investigation to see if it is possible to design a few standard Howe trusses for ordinary flat gravel roofs, that may be used for all of the ordinary variations of span, spacing, and effective depth of truss.

If such a range of usefulness for a few standard trusses can be clearly defined for each truss, a great amount of labor may be saved in their design, as it will only be necessary to pick out the standard truss that will suit the given case.

The diagrams and tables herewith presented are an effort in this direction, and are based upon a large number of actual designs made for the Public School Buildings of Chicago, by the author during the past eight years.

Figures 1, 2, and 3 show how the trusses were generally built. An even number of panels has always been used. The chords are shown parallel to each other, but in case it is found desirable to give the *top chord a slope of up to one-half inch for foot of span, this may be done* without affecting the validity of diagrams Figs. 5 and 6. Of course, in all cases the *effective depth of the truss will be the depth from center to center at chords at the middle of the span.*

The *inclination* of the diagonals has *never* been made *less than thirty degrees, and seldom more than forty-five degrees.* The standard trusses are designated by the number of the panels, and letters A to H inclusive. The former is given in diagram Fig. 5, and the latter in diagram Fig. 6.

The roof and the ceiling were constructed in the ordinary manner of wooden joists spaced not more than twenty inches on centers and running from truss to truss. *By help of these joists and the surrounding brick walls tied together in the proper manner, the trusses were efficiently braced sideways, so as to be safe against lateral flexure.*

The chords and diagonals were made of longleaf southern pine; the truss rods, of wrought iron; and the *washer plates* for the truss rods, *of steel or wrought iron.* The *wooden blocks* at the center joint were *made of oak,* and *the shoes at joint I were made of cast iron. All bolts were of wrought iron, three-quarters of an inch* in diameter, with washers at each end. These materials were carefully inspected, and all defective pieces rejected.

TABLE I

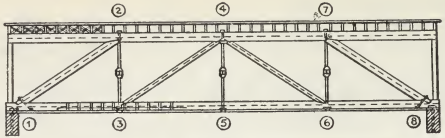
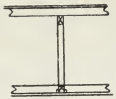


Fig. 1



L = Span of truss in feet.
S = Spacing of truss in feet.
D = Effective depth of truss in feet, or distance from center to center of chords.
B = Length of diagonal in feet from center to center of chords.
M = Bending moment in foot-pounds.

FOUR-PANEL HOWE TRUSSES

1	2	3	4	5	6	7	8	9	10
Truss Member	Max. M.	Min. Stress	Max. Stress	Truss A	Truss B	Truss C	Truss D	Truss E	Truss F
Top chord, 2—4	$-0.28\ L^2S$	$+2.25\ L^2S \div D$	$+\ 5.06\ L^2S \div D$	6×8	8×8	6×10	6×12	8×10	8×12
" " at 4	$-0.19\ L^2S$	$+3.00\ L^2S \div D$	$+\ 6.75\ L^2S \div D$	6×8	8×8	6×10	6×12	8×10	8×12
Bottom chord, 1—3	$-0.08\ L^2S$	$-2.25\ L^2S \div D$	$-\ 5.06\ L^2S \div D$	6×8	8×8	6×10	6×10	8×10	8×10
" " 3—5	$-0.05\ L^2S$	$-3.00\ L^2S \div D$	$-\ 6.75\ L^2S \div D$	6×8	8×8	6×10	6×10	8×10	8×10
Diagonal, 1—2		$+9.00\ LSB \div D$	$+20.25\ LSB \div D$	6×6	8×6	6× 8	6×10	8× 8	8× 8
" 3—4		$+1.125\ LSB \div D$	$+\ 8.63\ LSB \div D$	6×6	8×4	6× 6	6× 6	8× 6	8× 6
Tension rod, 2—3		$-3.00\ LS$	$-11.25\ LS$	1¼" dia.	1¼" dia.	1¼" dia.	1½" dia.	1½" dia.	1⅝" dia.
" " 4—5		$-1.50\ LS$	$-\ 3.00\ LS$	⅞" "	⅞" "	⅞" "	⅞" "	⅞" "	⅞" "
Rod bearing plate, 2 and 3		$-3.00\ LS$	$-11.25\ LS$	6×6×½	6×6×½	6×6×½	6×10×½	8×8×½	8×8×½
" " " 4 and 5		$-1.50\ LS$	$-\ 3.00\ LS$	4×4×⅜	4×4×⅜	4×4×⅜	5× 5×⅜	5×5×⅜	5×5×⅜
Shoulder depth at 1 and 2		$+2.25\ L^2S \div D$	$+\ 5.06\ L^2S \div D$	1¼"	1 "	1¼"	1½"	1½"	1½"
" " " 3 and 4		$+0.75\ L^2S \div D$	$+\ 1.69\ L^2S \div D$	¾"	⅜"	¾"	1 "	1 "	1 "
Length for horizontal shear		$-2.25\ L^2S \div D$	$-\ 5.06\ L^2S \div D$	Bolt 13"	Bolt 15"	Bolt 17"	Shoe 19"	Shoe 20"	Shoe 22"

NOTE—Add initial stresses to the above stresses.

TABLE II

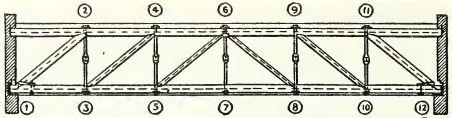
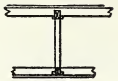


Fig. 2



L, S, D, B, and M = Same as given in Table I.

SIX-PANEL HOWE TRUSSES

Truss Member	Max. M.	Min. Stress	Max. Stress	Truss A	Truss B	Truss C	Truss D	Truss E	Truss F
Top chord, 2—4	—0.14 L^2S	+ 1.67 $L^2S \div D$	+ 3.75 $L^2S \div D$	6×8	8×8	6×10	6×12	8×10	8×12
" " 4—6	—0.10 L^2S	+ 2.67 $L^2S \div D$	+ 6.11 $L^2S \div D$	6×8	8×8	6×10	6×12	8×10	8×12
" " at 6	—0.115 L^2S	+ 3.00 $L^2S \div D$	+ 6.75 $L^2S \div D$	6×8	8×8	6×10	6×12	8×10	8×12
Bottom chord, 1—3	—0.040 L^2S	− 1.67 $L^2S \div D$	− 3.75 $L^2S \div D$	6×8	8×8	6×10	6×10	8×10	8×10
" " 3—5	—0.030 L^2S	− 2.67 $L^2S \div D$	− 6.11 $L^2S \div D$	6×8	8×8	6×10	6×10	8×10	8×10
" " 5—7	—0.033 L^2S	− 3.00 $L^2S \div D$	− 6.75 $L^2S \div D$	6×8	8×8	6×10	6×10	8×10	8×10
Diagonal, 1—2		+10.0 $LSB \div D$	+22.5 $LSB \div D$	6×6	8×6	6×8	6×8	8×8	8×8
" 3—4		+ 5.17 $LSB \div D$	+14.3 $LSB \div D$	6×6	8×4	6×6	6×6	8×6	8×6
" 5—6		− 0.50 $LSB \div D$	+ 7.0 $LSB \div D$	6×4	8×4	6×4	6×6	8×4	8×6
Tension rod, 2—3		− 6.33 LS	−16.17 LS	1¼" dia.	1⅜" dia.	1½" dia.	1¾" dia.	1¾" dia.	1⅞" dia.
" " 4—5		− 0.83 LS	− 8.67 LS	1 " "	1⅛" "	1⅛" "	1¼" "	1¼" "	1½" "
" " 6—7		− 1.00 LS	− 2.00 LS	⅞" "	⅞" "	⅞" "	⅞" "	⅞" "	⅞" "
Rod bearing plate, 2 and 3.		− 6.33 LS	−16.17 LS	6×6×½	6×8×½	6×10×½	6×12×⅝	8×10×⅝	8×12×¾
" " " 4 and 5.		− 0.83 LS	− 8.67 LS	5×5×⅜	6×6×½	6× 6×½	6× 6×½	6× 8×½	7× 7×½
" " " 6 and 7.		− 1.00 LS	− 2.00 LS	4×4×⅜	4×4×⅜	4× 4×⅜	4× 4×⅜	5× 5×⅜	5× 5×⅜
Shoulder depth, at 2		+ 1.67 $L^2SB \div D$	+ 3.75 $L^2S \div D$	1½"	1¼"	1¾"	1¾"	1½"	2 "
" " 3 and 4		+ 1.00 $L^2SB \div D$	+ 2.36 $L^2S \div D$	1¼"	1 "	1¼"	1¼"	1¼"	1¼"
" " 5 and 5		+ 0.33 $L^2SB \div D$	+ 0.64 $L^2S \div D$	¾"	¾"	¾"	¾"	¾"	¾"
Length for horizontal shear		+ 1.67 $L^2SB \div D$	− 3.75 $L^2S \div D$	Bolt 14"	Bolt 14"	Shoe 16"	Shoe 18"	Shoe 20"	Shoe 22"

NOTE—Add initial stresses to the above stresses.

TABLE III

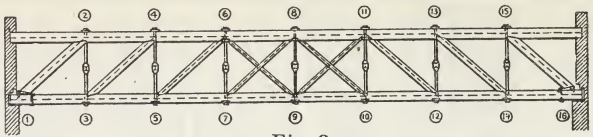


Fig. 3

L, S, D, B, and M—Same as given in Table I.

EIGHT-PANEL HOWE TRUSSES

Truss Member	Max. M	Min. Stress	Max. Stress	Truss C	Truss D	Truss E	Truss F	Truss G	Truss H
Top chord, 2—4	−0.079 L^2S	+1.31 $L^2S \div D$	+2.95 $L^2S \div D$	6×10	6×12	8×10	8×12	10×10	10×12
" " 4—6	−0.058 L^2S	+2.25 $L^2S \div D$	+5.06 $L^2S \div D$	6×10	6×12	8×10	8×12	10×10	10×12
" " 6—8	−0.064 L^2S	+2.81 $L^2S \div D$	+6.33 $L^2S \div D$	6×10	6×12	8×10	8×12	10×10	10×12
" " at 8	−0.062 L^2S	+3.00 $L^2S \div D$	+6.05 $L^2S \div D$	6×10	6×12	8×10	8×12	10×10	10×12
Bottom chord, 1—3	−0.023 L^2S	−1.31 $L^2S \div D$	−2.95 $L^2S \div D$	6×10	6×10	8×10	8×10	10×10	10×12
" " 3—5	−0.017 L^2S	- 2.25 $L^2S \div D$	−5.06 $L^2S \div D$	6×10	6×10	8×10	8×10	10×10	10×12
" " 5—7	−0.018 L^2S	−2.81 $L^2S \div D$	−6.33 $L^2S \div D$	6×10	6×10	8×10	8×10	10×10	10×12
" " 7—9	−0.018 L^2S	−3.00 $L^2S \div D$	−6.75 $L^2S \div D$	6×10	6×10	8×10	8×10	10×10	10×12
Diagonal, 1—2	.....	+10.5 LSB ÷ D	+23.6 LSB ÷ D	6×10	6×10	8×10	8×10	10×10	10×12
" 3—4	.....	+ 7.03 LSB ÷ D	+17.3 LSB ÷ D	6× 8	6× 8	8× 8	8× 8	10× 8	10×10
" 5—6	.....	+ 3.09 LSB ÷ D	+11.5 LSB ÷ D	6× 6	6× 6	8× 6	8× 6	10× 6	10× 8
" 7—8	.....	− 1.31 LSB ÷ D	+ 6.2 LSB ÷ D	6× 4	6× 4	8× 4	8× 6	10× 6	10× 6
Tension rod, 2—3	.....	−7.87 LS	−18.75 LS	1½" dia.	1¾" dia.	1¾" dia.	1⅞" dia.	2 " dia.	2¼" dia.
" " 4—5	.....	−4.03 LS	−12.87 LS	1¼" "	1¼" "	1½" "	1½" "	1⅝" "	1¾" "
" " 6—7	.....	+0.28 LS	− 7.41 LS	1 " "	1 " "	1¼" "	1½" "	1½" "	1¼" "
" " 8—9	.....	−0.75 LS	− 1.50 LS	⅞" "	⅞" "	1 " "	1 " "	1 " "	1 " "
Rod bearing plate, 2 and 3	.....	−7.87 LS	−18.75 LS	6×10×½	6×12×⅝	8×10×⅝	8×10×⅝	10×10×¾	10×10×¾
" " " 4 and 5	.....	−4.03 LS	−12.87 LS	6× 6×½	6× 6×½	8× 8×⅝	8× 8×⅝	8× 8×⅝	9× 9×⅝
" " " 6 and 7	.....	+0.28 LS	− 7.41 LS	5× 5×⅜	5× 5×⅜	6× 6×½	6× 6×½	6× 6×½	6× 6×½
" " " 8 and 9	.....	−0.75 LS	− 1.50 LS	4× 4×⅜	4× 4×⅜	5× 5×⅜	5× 5×⅜	5× 5×⅜	5× 5×⅜
Shoulder depth, at 2	.....	+1.31 $L^2S \div D$	+2.95 $L^2S \div D$	1¾"	1¾"	1¾"	2 "	2 "	2¼"
" " 3 and 4	.....	+0.94 $L^2S \div D$	+1.11 $L^2S \div D$	1¼"	1¼"	1¼"	1½"	1½"	1¾"
" " 5 and 6	.....	+0.56 $L^2S \div D$	+1.27 $L^2S \div D$	1 "	1 "	1 "	1¼"	1¼"	1¼"
" " 7 and 8	.....	+0.19 $L^2S \div D$	+0.42 $L^2S \div D$	¾"	¾"	¾"	1 "	1 "	1"
Length for horizontal shear	.....	−1.31 $L^2S \div D$	−2.95 $L^2S \div D$	Shoe 16"	Shoe 17"	Shoe 19"	Shoe 20"	Shoe 21"	Shoe 22"

NOTE—Add initial stresses to the above stresses.

The center lines of all truss members were as far as possible made to meet at one point. The chords and diagonals were made of solid timbers, no built-up member being used under any circumstances. This always insures the best job. *Welded heads were provided at both ends of the truss rods, and the screw threads for the turnbuckles were cut down on the rods. To avoid displacement, all oak blocks and diagonals were spiked to the chords.* To insure accurate workmanship, the *trusses were built on the ground and fitted together*, and *afterwards assembled in place.*

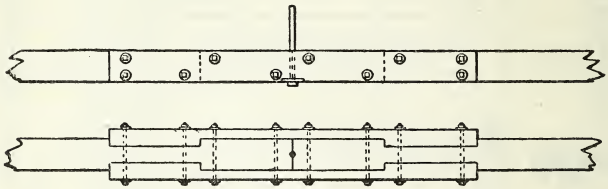


FIG. 4.

Bottom chord splices were made as shown in Figure 4. The bolts were not calculated to resist any stress, and were merely intended to hold the pieces together. The top chord splices were made in a similar manner, the notches only being omitted, and care was *taken to splice the top and bottom chords in different panels.*

At joint I the horizontal shearing area was always made large enough to resist the entire stress. Also at this joint the bolts are only intended to hold the pieces together. This rule is founded on experience, as it was observed by inspecting a number of old wooden trusses, that the nuts of the bolts were invariably loose, owing to the shrinkage of the lumber. It is, therefore, not correct to dimension the shearing area for part of the stress and the bolts for the balance. The whole stress must all either go one way or the other, and the joints must be so designed as to make this possible. An air space was provided around the ends of timbers projecting into brick walls, to avoid dry rot.

The roof loads in pounds per square foot were made up of *eighteen pounds dead load and twenty-four pounds live load—total forty-two pounds per square foot;* the *ceiling loads were six pounds dead load and six pounds live load—total twelve pounds per square foot.* The trusses are therefore figured for a *total load of 54 pounds per square foot* distributed as given above.

The maximum stresses due to these loads were found for each member of the truss. The maximum stresses for the

chords and end diagonals occur when the truss is fully loaded. This is not the case for the truss rods and other diagonals. For these members a distribution of the loads that partly covers the truss will cause the maximum or minimum stresses, and this distribution of the load occurs when the wind blows the snow over to one end of the truss.

In columns 2, 3, and 4 of Tables I, II, and III, the absolute minimum and maximum stresses are clearly indicated for each member of truss for the above loads, as well as the maximum bending moment in the chords at each truss rod. Cross diagonals or counter braces should be inserted wherever the diagonals and truss rods are subject to a reversal of stress.

Additional stresses in the truss are developed by screwing up the turnbuckles.

As it is possible to screw up the turnbuckles until the truss fails, it was specified that the turnbuckles should not be screwed tighter, but that one man could turn them conveniently with an iron bar two feet long. The allowance made in the trusses for the initial stresses thus produced was three thousand (3,000) pounds for 1¼ inch rods; for every eighth of an inch the rod was made less in diameter, two hundred (200) pounds was deducted; and for every eighth of an inch the rod was made larger in diameter, five hundred (500) pounds was added. This will give an initial stress of ten thousand (10,000) pounds for a three-inch diameter rod, a result that easily may occur in practice. The turnbuckles were screwed up until a camber of one two-hundredth of the span was obtained.

The following table gives the safe working stresses in pounds per square inch used for the design of these trusses:

KIND OF STRESS	LONGLEAF SOUTHERN PINE	WHITE OAK	WROUGHT IRON	CAST IRON
Tension	1,500		12,000	3,000
Bearing parallel with grain	1,600	1,500	15,000	10,000
Bearing across grain	350	500		
Shear parallel with grain	150	250	7,500	3,000
Shear across grain	1,000	800		

The maximum extreme fiber stress in the chords and diagonals due to the combined direct and bending stresses, was

taken at 1,500 pounds per square inch. The eccentrically loaded diagonals, being considered hinged at the ends, were calculated as if their ends were square, their length being taken equal to twice their actual length. The bending stresses in the chords are caused by the transverse loads for roof and ceiling, the chords being considered as beams continuous over several supports.

Diagrams Figs. 5 and 6 were made to fit a large number of

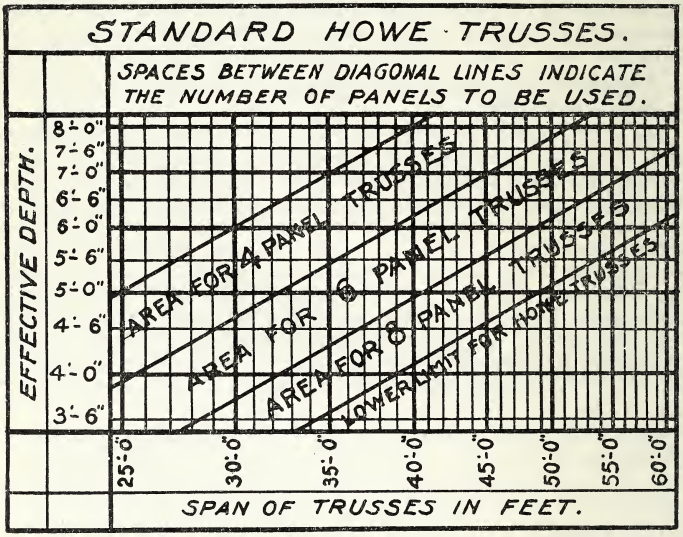


FIG. 5.

EXPLANATION—Find the intersection of the lines giving the span and the effective depth of the truss. The area between diagonal lines in which the point thus found is located, will give the number of panels that should be used in the truss.

actual designs of roof trusses calculated upon the above basis; and whenever either diagram is used, this must be distinctly understood. If desired, the diagram may be used as a check upon computations.

The total maximum and minimum stresses given in tables I, II and III hold good for any material, and do not include the initial stresses. In case it is desired to use other safe working stresses than those above given, design the truss directly from the maximum total stresses found from the tables.

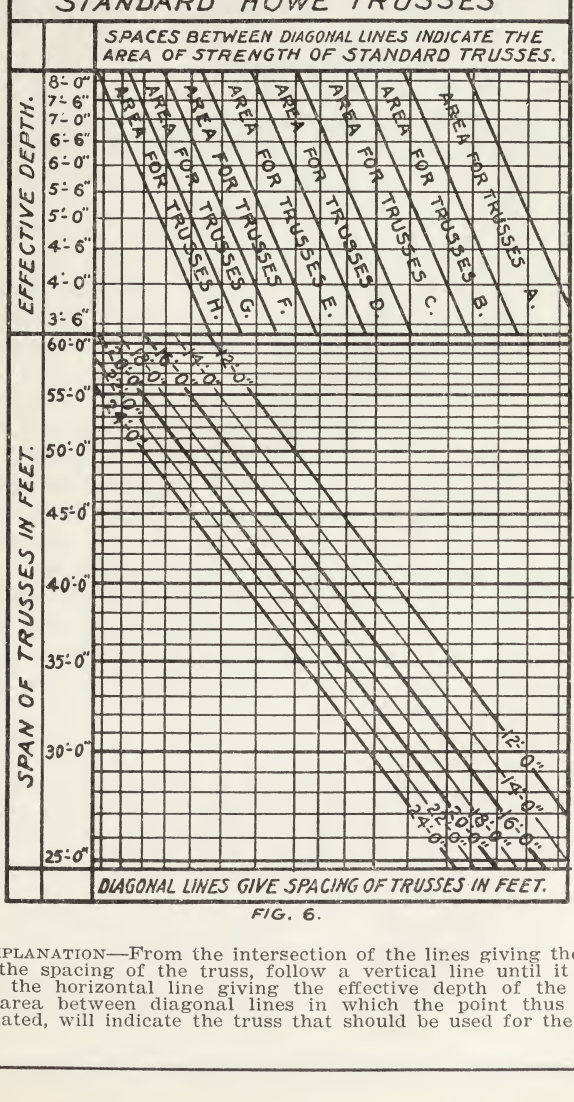


FIG. 6.

EXPLANATION—From the intersection of the lines giving the span and the spacing of the truss, follow a vertical line until it intersects the horizontal line giving the effective depth of the truss. The area between diagonal lines in which the point thus found is located, will indicate the truss that should be used for the given case.

The use of the diagrams may be illustrated by the following example: The span of a truss is 40′0″. The spacing is 18′0″, and the depth 6′0″ from center to center of chords. Total roof and ceiling load = 54 lbs. per square foot. Timber of L.L.S.P. Rods of wrought iron. From diagram Fig. 5, it will be seen that a 6-panel truss should be used; and from diagram Fig. 6, that truss D should be used. The sizes of all numbers for 6-panel truss D are already shown in the eighth column of table II, and the absolute maximum stresses in column 4.

PHYSICAL PROPERTIES OF YELLOW PINE

INTRODUCTION

Numerous investigators have made mechanical tests to determine the physical properties and the strength values of southern yellow pine, and naturally the tests were made in various ways. This has resulted in the preparation of tables, the values of which do not always agree; in fact, in many cases they appear to have a very wide range. It is of the utmost importance that, in using figures in any tables, a number of precautions be observed in the use of the data so presented. In Bulletin 556 of the United States Department of Agriculture a number of these precautions are given, which follow in more or less condensed form:

"Careful attention must be given to the natural variability of timber in order to make correct use of timber test data." The Forest Service calls attention to the necessity for remembering that in comparing the data in the latest publication (tables printed herein) "It must be kept in mind that scarcely any two series of tests have been made under the same conditions and that very frequently so little is specified concerning the character of the material and the method of tests as to make close comparisons impossible." "Comparisons should not be made with greater refinement than the data justifies."

The figures given in the tables which follow may be regarded as the latest and most trustworthy values and should supersede everything that has hitherto been published with reference to the strength of southern yellow pine.

Attention is also called to the tables which follow the strength factors giving the approximate figures for change of strength with change of moisture, etc., which should be used in connection with tables 1 and 2.

MECHANICAL PROPERTIES OF SOUTHERN PINE

(From Bulletin No. 556, United States Department of Agriculture, September 15, 1917)

TABLE 1.—*Results of tests on four species of Southern Pine tested in a green condition in the form of small clear pieces.*

Common and botanical name.	Locality where grown.	Number of trees.	Number of rings per inch.	Summerwood (per cent).	Moisture content (per cent).	Specific gravity oven dry, based on—		Weight per cubic foot (green) (pounds).	Shrinkage from green to oven-dry condition.			Static bending.					Impact bending.			Compression parallel to grain.			Compression perpendicular to grain—fiber stress at elastic limit (lbs. per sq. in.)	Shearing strength parallel to grain (pounds per square inch).	Tension perpendicular to grain (pounds per square inch).	Hardness, load required to imbed a 0.444-inch ball to one-half its diameter.	
						Volume when green.	Volume when oven-dry.		In volume (per cent of dimensions when green).	Radial (per cent of dimensions when green).	Tangential (per cent of dimensions when green).	Fiber stress at elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Work in bending— To elastic limit (inch-pounds per cubic inch).	Work in bending— To maximum load (inch-pounds per cubic inch).	Fiber stress at elastic limit (pounds per square inch).	Work in bending to elastic limit (inch-pounds per cubic inch).	Height of drop causing complete failure, 50-lb. hammer (inches).	Fiber stress at elastic limit (pounds per square inch).	Maximum crushing strength (pounds per square inch).				End (pounds).	Side (pounds).
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Pine, longleaf (Pinus palustris).	Florida, Louisiana, Mississippi.	34	18	39	47	.55	.64	50	12.3	5.3	7.5	5,400	8,700	1,630	1.00	8.0	10,800	3.5	34	3,840	4,390	600	1,070	290	550	590
Pine, shortleaf (Pinus echinata).	Arkansas, Louisiana.	12	12	40	64	.50	.58	50	12.6	5.1	8.2	4,500	8,000	1,450	.79	8.7	11,200	4.0	39	3,650	3,810	480	890	330	490	560
Pine, loblolly (Pinus tæda).	Florida, North Carolina, South Carolina.	15	8	42	70	.50	.59	54	12.6	5.5	7.5	4,400	7,500	1,380	.81	8.0	9,500	3.1	32	2,870	3,580	550	900	280	400	450
Pine, Cuban (Pinus heterophylla).	Florida	5	17	44	47	.58	.68	53	12.7	5.9	7.5	5,600	8,800	1,630	1.10	7.9	11,300	3.9	37	3,950	4,470	590	1,030	290	570	630

TABLE 2.—*Results of tests on four species of Southern Pine tested in an air-dry condition in the form of small clear pieces.*

Common and botanical name.	Locality where grown.	Number of rings per inch.	Summerwood (per cent).	Moisture content (per cent).	Specific gravity, oven dry, based on volume when air dry.	Weight per cubic foot (air dry) (pounds).	Static bending.				Impact bending.			Compression parallel to grain.		Compression perpendicular to grain—fiber stress at elastic limit (pounds per square inch).	Shearing strength parallel to the grain (pounds per square inch).	Tension perpendicular to grain (pounds per square inch).	Hardness, load required to imbed a 0.444-inch ball to one-half its diameter.	
							Fiber stress at elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Work in bending—	Fiber stress at elastic limit (pounds per square inch).	Work to elastic limit (inch-pounds per cubic inch).	Height of drop causing complete failure, 50-pound hammer (inches).	Fiber stress at elastic limit (pounds per square inch).	Maximum crushing strength (pounds per square inch).				End (pounds).	Side (pounds).
										To elastic limit (inch-pounds per cubic inch).										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Pine, longleaf (Pinus palustris).	Florida, Louisiana, Mississippi.	18	38	9.2	.66	42	11,800	16,700	2,200	3.58	11.3	16,400	6.6	32	9,250	10,880	1,670	1,640	420	1,140	1,020
Pine, shortleaf (Pinus echinata).	Arkansas, Louisiana.	10	40	11.0	.54	38	9,200	13,900	1,970	2.46	10.1	16,600	6.5	36	7,080	8,660	1,310	1,390	410	940	880
Pine, loblolly (Pinus taeda).	Florida	9	42	6.5	.57	38	11,700	15,600	2,130	3.70	9.0	14,800	5.9	26	7,980	11,300	1,600	1,720	370	1,030	840
Pine, Cuban (Pinus heteromylla).	Florida	17	44	8.8	.66	45	12,400	18,300	2,220	3.88	13.1	18,000	7.2	42	9,160	11,890	1,620	1,920	650	1,200	1,160

TABLE 3.—*Approximate figures for change of properties with change of moisture content; variation of properties with specific gravity; reliability of averages, and probable deviations from averages of individual trees and specimens. For use with Tables 1 and 2.*

Property.	Average increase (or decrease) in value effected by raising (or lowering) the moisture content 1 per cent when at about 12 per cent.	Approximate power of specific gravity according to which property varies.	Probable variation of present average (when from 5 trees) from true species average.	Probable variation of random tree from average for species.
1	2	3	4	5
	Per cent.		Per cent.	Per cent.
Specific gravity based on volume when green	.....	.....	1.7	3.8
Shrinkage	.....	1	.....	.....
Static bending:				
Fiber stress at elastic limit	6	1	5	12
Modulus of rupture	4	1	4	9
Modulus of elasticity	2	1	5	11
Work to elastic limit	8	2	7	16
Work to maximum load	[3] —1	2	6	14
Impact bending:				
Fiber stress at elastic limit	4	1	4	8
Work to elastic limit	5	2	5	12
Height of drop	[3] —3	2	7	15
Compression parallel to grain:				
Fiber stress at elastic limit	5	1	5	12
Crushing strength	4	1	4	9
Compression perpendicular to grain—fiber stress at elastic limit	6	2	6	14
Hardness, end	3	2	4	9
Hardness, side	1	2	5	10
Shearing strength parallel to grain	4	1	3	7
Tension perpendicular to grain	1	2	5	12

[3] The minus sign indicates decrease.

Important Note: "Safe working stresses for the design of working structural timbers should be based on the data in table 1 rather than in table 2." "It will be noted from tables 1 and 2 that in most properties the dry material excels the green. In structural design, however, no allowance should be made for such increase in strength, because in large timbers it is a very indefinite quantity. The increased strength of the wood fibres is usually offset by checks and other defects resulting from drying. Moreover, many structural timbers are subject to moisture changes and the outer fibres may at any time become wet enough to reduce the mechanical properties to the level of those of green timber. For these reasons the strength of green material should be made the basis of stress to be used in structural design."

DEFINITIONS OF TERMS USED IN TABLES ON PHYSICAL PROPERTIES OF SOUTHERN PINE

(Reprinted from Bulletin 556, United States Department of Agriculture, Sept. 15, 1917.)

ELASTIC LIMIT

The elastic limit (sometimes called proportional limit) is that point where the distortion ceases to be in proportion to the load. For example, if a beam deflects one-sixteenth of an inch with a 50-pound load it will deflect one-eighth of an inch with 100 pounds, and so on, each additional load of 50 pounds causing an additional deflection of one-sixteenth of an inch until the "elastic limit" is reached, after which the deflections increase more rapidly than the increase in load.

A timber stressed beyond the elastic limit will not resume its original form immediately upon the removal of the load.

ELASTICITY

Elasticity is the property (possessed by most materials) of changing form with the application of force and recovering at once upon release from the force.

In any elastic material the amount of compression or deformation is proportional to the force applied.

Air and other gases under compression are elastic. The most commonly recognized elastic material is rubber. Timber is elastic within comparatively narrow limits.

The term "very elastic" as applied to wood is indefinite, because it may mean that the force required to produce a given deformation is great and the recovery sudden as in an ivory ball (see "Modulus of elasticity"); or that the amount of distortion to the elastic limit is great, as in a rubber ball, or that the wood possesses high elastic resilience, a combination of the two properties.

FIBER SATURATION POINT

Green wood usually contains water within the cell walls and "free" water in the pores. In drying, the water in the pores is the first to be evaporated. The fiber saturation is that point at which no water exists in the pores of the timber but at which the cell walls are still saturated with moisture. The fiber saturation point varies with the species. The ordinary proportion of moisture—based on the dry weight of the wood —at the fiber saturation point is from 20 to 30 per cent.

FIBER STRESS AT ELASTIC LIMIT

Fiber stress at elastic limit is the stress obtained in a timber by loading it to its elastic limit. It is the greatest stress the timber will take under a given loading and immediately return to its former position.

FLEXIBILITY

Flexibility is that quality which renders a material capable of being bent without breaking. Thus, green timber is more flexible than dry.

GREEN

Green is the condition of timber as taken from the living tree.

Immediately upon being sawed from the tree lumber begins to lose moisture and otherwise change its condition. The rapidity of these changes is determined by the species, humidity, and circulation of air, heat, etc.

MECHANICAL PROPERTIES

Mechanical properties are the properties of wood which enable it to resist deformations, loads, shocks, or forces. Thus the ability to resist shearing forces is a mechanical property of timber. (See "Strength.")

MODULUS OF ELASTICITY

Modulus of elasticity is the ratio of stress per unit area to corresponding strain per unit length, the distortion or strain being within the elastic limit.

Numerically, the modulus of elasticity of a material is the force in pounds required to stretch a sample of that material with a cross-sectional area of 1 square inch to double its length, on the assumption that the fibers would not be stressed beyond their elastic limit. India rubber has a very low modulus of elasticity, while that of steel is very high. It is, then, the measure of the stiffness or rigidty of a substance.

MODULUS OF RUPTURE

Modulus of rupture is the computed fiber stress in the outermost fibers of a beam at the maximum load and is a measure of the ability of a beam to support a slowly applied load for a very short time. The formula by which modulus of rupture is computed is the same as that for fiber stress at elastic limit, the maximum load being substituted for the elastic limit load. The assumptions on which this formula are based hold only up to the elastic limit, hence modulus of rupture is not a true fiber stress. It is, however, a universally accepted term, and the values are quite comparable for various species and sizes of timber. It is a definite quantity, and the personal factor does not enter to any great extent into obtaining it. It is consequently not so subject to error as the fiber stress at elastic limit, and for that reason is used more than any other value to represent the strength of wood. Modulus of rupture should always be considered in calculating the strength of beams to be used as stringers, floor joists, etc.

PHYSICAL PROPERTIES

Physical properties, as the term is used in this bulletin, are those properties of wood which have to do with its structure, such as density, cell arrangements, fiber length, etc. In its broad sense the term physical properties includes all those properties listed as mechanical properties as well as those pertaining to its structure.

RADIAL

Radial means extending outward from a center or an axis. Thus a radial surface in a tree is one extending from the pith of the tree outward, such as the wide faces of a quarter-sawed board.

RINGS

Rings are those circular markings around the center of a tree section which are produced by the contrast in density, hardness, color, etc., between springwood and summerwood. One ring, known as an annual ring, consists of a layer of springwood and a layer of summerwood.

SHEAR

Shear is the name of the stress which tends to keep two adjoining planes or surfaces of a body from sliding, one on the other, under the influence of two equal and parallel forces acting in opposite directions. A force which produces shear (or shearing stress) in a material is called a shearing force.

SPRINGWOOD

The lighter and more porous layer of wood in the annual rings of a tree is known as the springwood or early wood. As the name implies, it is produced in spring growth, or in the earlier part of the growing season.

STRAIN

The deformation or distortion produced by a stress or force is known as strain.

STRENGTH

The term "strength" as ordinarily used is a very indefinite one. It is usually thought of in connection with external loads or forces.

Strength in its broad sense is a measure of the mechanical properties, or of the ability of a timber to resist stress or deformation. Thus, strength in shear, strength as a beam, strength as a post, hardness, stiffness, toughness. These last three properties are not always thought of in connection with the term strength, but are unconsciously included whenever they are important in a specific use.

Seldom, if ever, do any two species contain all the various properties in the same degree. This accounts for the special uses of the different species.

Much confusion often arises from comparing species for a special use on the basis of properties or strength values not of first importance in the specific instance.

STRESS

Stress is distributed force.

Fiber stress is the distributed force tending to compress, tear apart, or change the relative position of the wood fibers.

Stress is measured by the force per unit area. Thus a short column 2 inches squares (4 square inches) and supporting a load of 2,000 pounds will be under a stress or fiber stress of 500 pounds per square inch.

SUMMERWOOD

Summerwood is that denser layer of wood in the annual rings of a tree which is put on in summer or the latter part of the growing season.

TANGENTIAL

Tangential, as applied in this publication, means tangent to or parallel to the curves of the annual rings in a cross section. Thus a tangential surface is a surface perpendicular to the radius of a tree.

WORK

Work is the product of force and distance, or force acting through distance.

Work is essential in stopping bodies in motion, or in causing motion or change of motion of bodies.

Work is measured in inch-pounds, foot-pounds, etc.

An inch-pound is the work required to raise one pound 1 inch or to move a body 1 inch against a resistance of 1 pound.

FORMULÆ USED IN COMPUTING

LEGEND

A = Area of cross section; square inches.

B = Area under plate in compression-perpendicular-to-grain tests, square inches.

CS = Crushing strength, pounds per square inch.

E = Modulus of elasticity, pounds per square inch.

EL = Fiber stress at elastic limit, pounds per square inch.

J = Greatest calculated longitudinal shear, pounds per square inch.

K = Constant = 27.7 when weight is in pounds; 0.061 when weight is in grams.
MR = Modulus of rupture, pounds per square inch.
P = Maximum load, pounds.
P′ = Load at elastic limit, pounds.
S = Dry specific gravity.
Δ = Total deflection or compression at elastic limit, inches.
b = Width, inches.
d = Distance between centers of collars, inches.
h = Height, inches.
l = Span, inches (in compression parallel to grain l = length).

BENDING

Load applied at center:

$$J = \frac{0.75 \times P}{b \times h}$$

$$MR = \frac{1.5 \times P \times l}{b \times h^2}$$

$$EL = \frac{1.5 \times P' \times l}{b \times h^2}$$

$$E = \frac{P' \times l^3}{4 \times b \times h^3 \times \Delta}$$

Uniformly distributed load:

$$J = \frac{0.75 \times P}{b \times h}$$

$$MR = \frac{0.75 \times P \times l}{b \times h^2}$$

$$EL = \frac{0.75 \times P' \times l}{b \times h^2}$$

$$E = \frac{P' \times l^3}{6.4 \times b \times h^3 \times \Delta}$$

Any loading:

$$M = 1/6\, F \times b \times h^2.$$

Where M = moment in inch-pounds either external or internal.

F = fiber stress for moment M.

$J = 3/2 \times \frac{V}{b \times h}$ where J = unit horizontal shear at any point and V = total vertical shear at that point.

COMPRESSION PARALLEL TO GRAIN

$$CS = \frac{P}{A}$$

$$EL = \frac{P'}{A}$$

$$E = \frac{P' \times d}{A \times \Delta}$$

COMPRESSION PERPENDICULAR TO GRAIN

$$EL = \frac{P'}{B}$$

SHEAR PARALLEL TO GRAIN

$$Shear = \frac{P}{A}$$

SPECIFIC GRAVITY

$$S = \frac{\text{weight} \times K}{\left(1 + \% \frac{\text{moisture}}{100}\right) \times \text{volume of piece in cubic inches.}}$$

STRENGTH AND STIFFNESS OF NATURAL AND TREATED STRINGERS.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE BULLETIN No. 286.

SEPTEMBER 27, 1915.

THE TREATED PIECES WERE TREATED WITH CREOSOTE BY THE BETHELL PROCESS

Species and condition.	Modulus of rupture (pounds per square inch)		Modulus of elasticity (1,000 pounds per square inch)		Fiber stress at elastic limit (pounds per square inch)		Shearing stress at maximum load (pounds per square inch)	
	Natural	Treated	Natural	Treated	Natural	Treated	Natural	Treated
Longleaf pine:								
Partially air dry, 10 tests—								
Average	5,151	5,132	1,409	1,275	3,346	2,898	408	399
Maximum	5,575	5,830	1,617	1,462	4,180	3,970	438	452
Minimum	4,150	4,600	1,235	1,113	2,390	2,050	325	357
Air dry, 10 tests—								
Average	6,466	6,376	1,561	1,471	4,950	4,762	499	499
Maximum	8,600	7,620	1,767	1,742	6,040	5,530	658	595
Minimum	4,280	5,260	1,236	1,227	3,450	3,740	320	408
Loblolly pine:								
Partially air dry, 10 tests—								
Average	4,858	4,150	1,296	1,155	2,738	2,080	402	339
Maximum	6,440	4,960	1,515	1,234	3,250	2,340	535	409
Minimum	3,680	3,390	1,089	1,030	2,160	1,830	301	275
Air dry, 10 tests—								
Average	6,392	5,380	1,534	1,297	4,806	3,808	507	437
Maximum	7,680	6,270	1,596	1,367	5,430	4,580	624	509
Minimum	4,510	4,360	1,430	1,238	3,910	3,520	362	361

TREATED TIMBERS

UNIVERSITY OF ILLINOIS,
ENGINEERING EXPERIMENT STATION
BULLETIN NO. 41
DEC. 12, 1909

TESTS OF TIMBER BEAMS

by

Professor A. N. Talbot

SUMMARY OF RESULTS OF TESTS

Bridge stringers 8″x16″x15′0″ to 7″x12″x14′0″ in size.

(Pounds per square inch)

	Long-leaf†	Shortleaf		Loblolly††	
		Not treated	Treated*	Not treated	Treated*
Total number of tests	34	4	8	18	20
Percentage of horizontal shear failures	73.5	100	75	55.5	30
Average horizontal shearing stress at failure	362	364	302	306	301
Average fibre stress at elastic limit	4359	4343	3386	3160	3084
Average fibre stress at failure	5374	4886	4078	4280	4227
Failing by horizontal shear, number	25	4	6	10	6
Average horizontal shearing stress at failure	380	364	302	334	281
Lowest horizontal shearing stress at failure	188	293	224	253	224
Highest horizontal shearing stress at failure	497	505	410	388	391
Average fibre stress at failure	5504	4886	4082	4596	3816
Lowest fibre stress at failure	2640	4005	3025	3760	3020
Highest fibre stress at failure	7260	6810	5550	5740	6020
Failing by tension or compression, number	9	.....	2	8	14
Average horizontal shearing stress at failure	310	.....	302	272	309
Lowest horizontal shearing stress at failure	191	.....	250	164	202
Highest horizontal shearing stress at failure	471	.....	357	334	420
Average fibre stress at failure	5013	.....	4067	3882	4404
Lowest fibre stress at failure	2860	.....	3405	2530	2660
Highest fibre stress at failure	8410	.....	4730	5130	6080
Small beams—					
Average horizontal shearing stress at failure	535	.....	.....	375	383
Average fibre stress at elastic limit	6549	.....	.....	4485	4945
Average fibre stress at failure	8601	.....	.....	6035	6210
Shear blocks—					
Average shearing stress	432	.....	.....	403	441

*Treated with creosote.
†Series A and B.
††Series C and D.

AMERICAN RAILWAY ENGINEERING ASSOCIATION

BULLETIN No. 149

SEPT. 1912

Tests made by H. B. MacFarland, Engineer of Tests for the Atchison, Topeka & Santa Fe Railway System at Topeka, Kansas, are reported in Bulletin 149 of the American Railway Engineering Association, September, 1912. In these tests thirty-two standard longleaf Yellow Pine stringers 7"x16"x 28'0" were tested. The stringers were cut in two equal lengths and one-half of each stringer was creosoted by the full cell process. The tests were made on a net span of 13' 0" making the ratio l/d equal to 9.4 and as a natural result 80% of the pieces failed in horizontal shear along the neutral axis.

It is evident that the true modulus of rupture was not developed but rather that the actual horizontal shearing stress was developed.

The following results, expressed in pounds per square inch were obtained:

Bending.

Modulus of rupture,	untreated	4955
	treated	5122
Elastic limit,	untreated	4055
	treated	4272
Maximum horizontal shear,	untreated	396
	treated	411
Modulus of elasticity in 1000 pounds,	untreated	1575
	treated	1572

Compression parallel to grain.

Elastic limit,	untreated	5176
	treated	5162
Modulus of elasticity in 1000 pounds,	untreated	575
	treated	600
Maximum load,	untreated	6069
	treated	6045

Compression perpendicular to grain.

Elastic limit,	untreated	1008
	treated	1047

Mr. McFarland concludes as follows: "The data show conclusively that longleaf pine timber which has been subjected to the full cell process of creosoting and allowed to weather for a year is in no way inferior to untreated timber. When tested immediately after treatment, the results show the treated timber to be slightly inferior to the untreated timber."

The effects of turpentining longleaf Yellow Pine trees has generally been regarded as injurious to the timber. This matter was fully investigated by the Forestry Division and the result of the investigation set forth in Bulletin No. 8, concluding by stating that "The results (of the tests) prove conclusively that, to say the least, the extracting of the turpentine from longleaf Yellow Pine trees does not in any material sense injure them, so far as strength qualities are concerned."

"The intimate relation of strength and specific weight has been well established by the experiments." (Circular 12, Division of Forestry.)

"That within the same species the strength of wood varies with the dry weight (specific gravity), i. e., that the heavier stick is the stronger, has been known for some time. That this law of variations holds good not only for a given species but irrespective of species for the four principal pines of our Southern States. This fact becomes the more important in practical application, as the wood of these species of pines so far can not be distinguished at all by its anatomical structure and only with difficulty and uncertainty by other appearances." (Circular 15, Division of Forestry.)

DEFINITION FOR SOUTHERN YELLOW PINE.

(*Authorized reprint from the copyrighted Standards of The American Society for Testing Materials, Philadelphia, Pa.*)

SOUTHERN YELLOW PINE.—This term includes the species of yellow pine growing in the Southern States from Virginia to Texas, that is, the pines hitherto known as long leaf (Pinus palustris), short leaf pine (Pinus echinata), loblolly pine (Pinus taeda), Cuban pine (Pinus heterophylla) and pond pine (Pinus serotina).

Under this heading two classes of timber are designated: (A) dense Southern yellow pine and (B) sound Southern yellow pine. It is understood that these two terms are descriptive of quality rather than of botanical species.

(a) *Dense Southern Yellow Pine* shall show on either end an average of at least six annual rings per inch and at least one-third summer wood, or else the greater number of the rings shall show at least one-third summer wood, all as measured over the third, fourth, and fifth inches of a radial line from the pith. Wide-ringed material excluded by this rule will be acceptable, provided that the amount of summer wood as above measured shall be at least one-half.

The contrast in color between summer wood and spring wood shall be sharp and the summer wood shall be dark in color, except in pieces having considerably above the minimum requirement for summer wood.

In cases where timbers do not contain the pith, and it is impossible to locate it with any degree of accuracy, the same inspection shall be made over 3″ on an approximate radial line beginning at the edge nearest the pith in timbers over 3″ in thickness and on the second inch (on the piece) nearest to the pith in timbers 3″ or less in thickness.

In dimension material containing the pith but not a 5″ radial line, which is less than 2x8″ in section or less than 8″ in width, that does not show over 16 sq.in. on the cross-section, the inspection shall apply to the second inch from the pith. In larger material that does not show a 5″ radial line the inspection shall apply to the three inches farthest from the pith.

The radial line chosen shall be representative. In case of disagreement between purchaser and seller the average summer wood and number of rings shall be the average of the two radial lines chosen.

(b) *Sound Southern Yellow Pine* shall include pieces of Southern pine without any ring or summer wood requirement.

GENERAL TIMBER SPECIFICATIONS

Southern Yellow Pine Timbers are graded in accordance with the several rules herein described. The defects enumerated and admitted in the various grades are described as follows:

KNOTS

(*Adopted by the American Society for Testing Materials, August* 21, 1915.)

1. Knots shall be classified as round and spike in form and for quality as sound, encased, loose and unsound; knots are also classed as to size.

2. *Sound Knot.*—A sound knot is one which is solid across its face and which is as hard as the wood surrounding

it; it may be either red or black, and is so fixed by growth or position that it will retain its place in the piece.

3. *Loose Knot.*—A loose knot is one not firmly held in place by growth or position.

4. *Pith Knot.*—A pith knot is a sound knot with a pith hole not more than ¼ inch in diameter.

5. *Encased Knot.*—An encased knot is one whose growth rings are not intergrown and homogeneous with the growth rings of the piece it is in. The encasement may be partial or complete; if intergrown partially or so fixed by growth or position that it will retain its place in the piece, it shall be considered a sound knot; if completely intergrown on one face, it is a watertight knot.

6. *Unsound Knot.*—An unsound knot is one not as hard as the wood it is in.

7. *Pin Knot.*—A pin knot is a sound knot not over ½ inch in diameter.

8. *Standard Knot.*—A standard knot is a sound knot not over 1½ inches in diameter.

9. *Large Knot.*—A large knot is a sound knot more than 1½ inches in diameter.

10. *Round Knot.*—A round knot is one which is oval or circular in form.

11. *Spike Knot.*—A spike knot is one sawn in a lengthwise direction; the mean or average width shall be considered in measuring these knots.

WANE

12. Wane is bark, or the lack of wood from any cause, on edges of timbers.

SHAKES

13. Shakes are splits or checks in timbers which usually cause a separation of the wood between annual rings.

14. *Ring Shake.*—An opening between the annual rings. (See Insert Fig. 1.)

15. *Through Shake.*—A shake which extends between two faces of a timber. (See Insert Fig. 2.)

16. Shakes not hereinbefore described, unless known to have extensive penetration, shall not be considered a defect under this classification.

SIZES

17. All rough timber, except No. 1 Common, must be full size when green. One-quarter inch shall be allowed for each side surfaced.

LENGTHS

18. Standard lengths are multiples of two feet, eight to twenty feet, inclusive; extra lengths are multiples of two feet, twenty-two feet and longer. When lineal average is specified, standard of lengths shall be multiples of one foot.

GRADES OF TIMBERS

HEART TIMBERS

19. All timber specifications, except "Merchantable" and "Select Structural Timbers" specifying heart requirements, shall be considered as a special contract, and shall specify whether the heart requirements refer to surface or girth measurements in each piece.

NO. 1 COMMON TIMBERS

20. No. 1 Common Timbers may be either Dense or Sound Pine.

21. Unless otherwise specified, this grade will admit any amount of sapwood.

22. No. 1 Common Timbers, rough, 4x4 and larger, may be ¼″ scant in either or both of its dimensions, shall be well manufactured and may have 1½″ wane on one corner one-third the length of the piece, or its equivalent on two or more corners, the wane measured on its face.

23. Timbers 10x10 in size may have 2″ wane as above; the larger sizes may have wane as above in proportion to sizes.

24. No. 1 Common Timbers may contain sound knots and pith knots, provided that the diameter of any one knot shall not exceed the following in size:

2″	in	4x 4 to 6x 6
2½″	in	6x 8 to 8x10
3″	in	10x10 to 10x12
3½″	in	12x12 to 12x14
4″	in	14x14 to 14x16
4½″	in	16x16 to 16x18

In sizes not mentioned the diameter of knots admissible will increase or decrease in proportion to the size of the timbers on same basis as above specified.

25. No. 1 Common Timbers will admit shakes extending one-sixth the length of the piece, round or ring shakes, unsound knots 1½ inch or less in diameter, a limited number of pin worm holes well scattered, sap stain and seasoning checks. Unless otherwise specified, this grade will admit any amount of sap stain.

SQUARE EDGE AND SOUND TIMBERS

27. Square Edge and Sound Timbers may be either Dense or Sound Pine.

28. Unless otherwise specified, this grade will admit any amount of sapwood.

29. Square Edge and Sound Timbers shall be well manufactured and shall be free from defects such as injurious ring or round shakes and through shakes that extend to the surface, unsound and loose knots and knots in groups that will materially impair the strength and shall be free from wane. Seasoning checks and sap stain shall not be considered defects.

MERCHANTABLE TIMBERS

30. Merchantable Timbers may be either Dense or Sound Pine.

31. All Merchantable Timbers shall be well manufactured and shall be free from defects such as injurious ring and round shakes and through shakes that extend to the surface, unsound and loose knots and knots in groups that will materially impair the strength. Seasoning checks and sap stain shall not be considered defects.

32. Sizes under 9″ on the largest dimension, shall show two-thirds or more heart surface on one of the wide faces; sizes 9″ and over on the largest dimension shall show two-thirds or more heart on both of the wide faces. When sticks are square the face showing the most heart shall govern the inspection on sizes under 9″ and the two faces showing the most heart shall govern the inspection when 9″ and over. Heart showing the full length, even if not two-thirds of the area as above, shall meet the requirements of this quality.

33. Wane not exceeding one-eighth of the dimension of the face and one-quarter of the length of the piece on one corner, or the equivalent on two or more corners on not to exceed ten per cent of the pieces, shall be admitted.

SELECT STRUCTURAL MATERIAL

(*A rule incorporating suggestions by the United States Forest Service.*)

REQUIREMENTS FOR DENSITY AND RATE OF GROWTH

34. Select Structural Material shall contain only sound wood and be well manufactured, and shall conform to the definition of Dense Southern Pine as adopted by the American Society for Testing Materials, August 21st, 1915.

35. Unless otherwise specified, Select Structural Material shall show 85 per cent of heart, girth measurement, measured anywhere in the length of the piece. Any greater or less requirement as to heart shall be expressed in terms of per cent of girth measurement. Sap stain is not a defect in this grade.

36. For the purpose of determining whether any given piece meets the requirements for density and rate of growth, the following rule, suggested by the United States Forest Service, shall be applied. It will be sufficient if either end passes the inspection.

(1) *Pith Present or Accurately Located.*

(A) Radial line of 5″ present.

(a) Apply inspection over third, fourth and fifth inches. (See Insert Fig. 3.)

(B) Radial line of 5″ not present.

(a) Apply inspection to the second inch on 2x3, 2x4, 2x6, 3x3, 3x4, 4x4, or any other dimension material that has less than 16 square inches on the cross section. (See Insert Fig. 4.)

(b) In the larger material apply inspection to the 3 inches farthest from the pith. (See Insert Fig. 5.)

(2) *Pith Not Present or Cannot Be Accurately Located.*

(A) Material over 3″ thick apply inspection to three inches nearest the pith. (See Insert Fig. 6.)

(B) Dimension material 3″ or less in thickness apply inspection to second inch of the piece nearest the pith. (See Insert Fig. 7.)

(3) *The Radial Line Chosen Shall Show a Representative Number of Annual Rings of Growth and Per Cent of Summer Wood.*

RESTRICTIONS ON KNOTS IN BEAMS

37. Beams shall not have in Volume 1 sound knots greater in diameter than one-fourth the width of the face on which they appear—maximum knot 1½″. Shall not have in Volume 2 sound knots greater in diameter than one-half the width of the face on which they appear—maximum knot 3″. (See Insert Fig. 8.)

38. The aggregate diameter of all knots within the center half of the length of any face shall not exceed the width of that face.

39. The diameter of a knot on the narrow or horizontal face of a beam is to be taken as its projection on a line per-

pendicular to the edge of the timber. On the wide or vertical face, the smallest dimension of a knot is to be taken as its diameter. (See Insert Fig. 9.)

RESTRICTIONS ON KNOTS IN COLUMNS

40. Columns shall not have knots greater in diameter than one-third the least width of the column—maximum knots 4 inches.

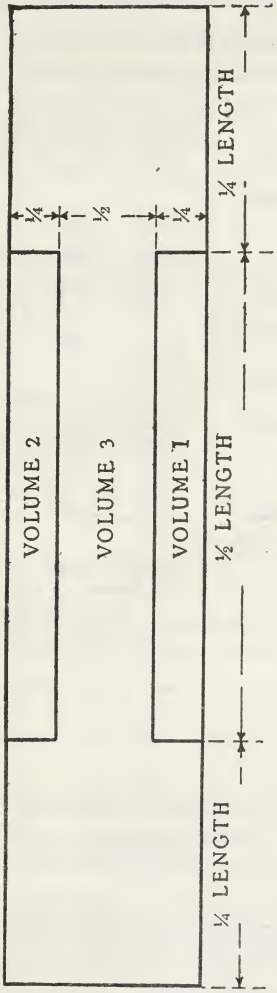
RESTRICTIONS ON SHAKES AND CHECKS IN BEAMS

41. Round or ring shakes shall not occupy, at either end of a timber, more than one-fourth the width of green material, nor more than one-third the width of seasoned material. (See Insert Figs. 1 and 10.)

42. Any combination of checks and shakes which would reduce the strength to a greater extent than the allowable round-shakes will not be permitted. Shakes shall not show on the faces of either green or seasoned timber. (See Insert Fig. 11.)

RESTRICTIONS ON CROSS GRAIN IN BEAMS

43. Beams shall not have diagonal grain with slope greater than one in twenty in Volume 1. (See Insert Fig. 12.)


¼
⅓
¼
¼ LENGTH
VOLUME 2
VOLUME 3
VOLUME 1
½ LENGTH
¼ LENGTH

DIVISION OF FORESTRY, BULLETIN No. 12

RECOMMENDED WORKING STRESS

(Pounds per square inch)

Longleaf Yellow Pine.	Ultimate	Class A	Class B	Class C	Class D
Modulus of strength at rupture	7750	1550	1782	2170	2400
Crushing endwise	5000	1000	1150	1400	1550
Shearing with grain	500	125	125	125	125
Modulus of elasticity in 1000 pounds	1440	720	720	720	720
Shortleaf Yellow Pine.					
Modulus of strength at rupture	6500	1300	1404	1534	1625
Crushing endwise	4200	840	907	991	1050
Shearing with grain	400	100	100	100	100
Modulus of elasticity in 1000 pounds	1200	600	600	600	600

Class A. (18% moisture)—Structures freely exposed to the weather, such as railway trestles, uncovered bridges, etc.

Class B. (15% moisture)—Structures under roof but without side shelter, fully exposed to outside air, but protected from rain, such as roof trusses of open shops and sheds, covered bridges over streams, etc.

Class C. (12% moisture)—Structures in buildings unheated but more or less protected from outside air, such as roof trusses of barns, enclosed shops and sheds, etc.

Class D. (10% moisture)—Structures in buildings at all times protected from the outside air, heated in winter, such as roof trusses in houses, halls, churches, etc.

For recommended formula for columns, see page 48.

ASSOCIATION OF
RAILWAY SUPERINTENDENTS OF BRIDGES
AND BUILDINGS

(Now the American Railway Bridge and Building Association)

STRENGTH OF BRIDGE AND TRESTLE TIMBERS

(Recommended October, 1895.)

(Pounds per square inch)

			Long-leaf	Short-leaf
Transverse, extreme fibre stress	ultimate	stress	7000	6000
	working	"	1200	1000
Modulus of elasticity in 1000 pounds	ultimate	"	1700	1200
	working	"	850	600
Compression, with grain. End bearing	ultimate	"	8000	6000
	working	"	1600	1200
Columns under 15 diameters	ultimate	"	5000	4000
	working	"	1000	800
Compression, across grain	ultimate	"	1400	1000
	working	"	350	250
Shearing. With grain	ultimate	"	600	400
	working	"	150	100
Across grain	ultimate	"	5000	4000
	working	"	1250	1000
Tension. With grain	ultimate	"	12000	9000
	working	"	1200	900
Across grain	ultimate	"	600	500
	working	"	60	50

The American Civil Engineers' Pocket Book recommends the following: "Increase the above stresses as follows: for highway bridges and trestles 20 per cent; for protected timbers, as in a building 30 per cent."

It will be noted that the tabular stresses are for railroad bridges and trestles.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION

(Now the American Railway Engineering Association)

WORKING UNIT-STRESSES FOR STRUCTURAL TIMBER*

(Expressed in pounds per square inch)

(Adopted March, 1909.)

		Long-leaf	Short-leaf
Bending, extreme fibre stress,	average ultimate	6500	5600
	working stress*	1300	1100
Modulus of elasticity in 1000 pounds		1610	1480
Shearing.			
Parallel to grain,	average ultimate	720	710
	working stress*	180	170
Longitudinal shear in beams,	average ultimate	300	330
	working stress*	120	130
Compression.			
Perpendicular to the grain,	elastic limit	520	340
	working stress*	260	170
Parallel to the grain,	average ultimate	3800	3400
	working stress*	1300	1100
For columns under 15 diameters,	working stress*	980	830
Ratio of length of stringer to depth		10	10

Formulas for working stress in long columns over 15 diameters.

Longleaf. $1300\ (1-l/60d)$.

Shortleaf. $1100\ (1-l/60d)$.

in which

l = length in inches.

d = least side in inches.

These unit stresses are for a green condition of timber and are to be used without increasing the live load stresses for impact.

*NOTE.—These unit stresses may be **increased fifty (50) per cent** for buildings and similar structures, in which the timber is protected from the weather and practically free from impact. For highway bridges and

trestles the unit-stresses may be increased twenty-five (25) per cent. To compute the deflection of the beam under long-continued loading instead of that when the load is first applied, only fifty (50) per cent of the corresponding modulus of elasticity given in the table is to be employed. The working unit-stresses given in this table are intended for railroad bridges and trestles.

Of these recommended working stresses, those given in Bulletin 12, Division of Forestry, are probably too high for the modulus of strength at rupture for general use, although these stresses could be used in connection with careful designing and carefully selected materials. But Yellow Pine has had ample and extensive usage in accordance with the stresses recommended by the American Railway Bridge and Building Association and the American Railway Engineering Association, increased as recommended for use in buildings. In many cities these are the lawful working stresses specified by the Building Codes; and these stresses have been used extensively where the construction of buildings is not governed by such Codes, and all with satisfactory results.

In the light of successful and satisfactory usage and the results of authoritative tests, the SOUTHERN PINE ASSOCIATION recommend the following working stresses, expressed in pounds per square inch:

	Dense Southern Yellow Pine	Sound Southern Yellow Pine
Bending, extreme fibre stress	1800	1500
Horizontal shear in beams	175	150
Compression with grain	1800	1500
Compression across the grain	350	275

For columns, square end bearing and symmetrically loaded:

Dense Southern Yellow Pine 1500 $(1—l/80d)$.
Sound Southern Yellow Pine 1300 $(1—l/80d)$.

The above working stresses to be used in buildings where the material is protected from the weather and not subject to severe impact loads or other unusual conditions.

The modulus of elasticity used in preparing that portion of the tables pertaining to the deflection of the beams is the average of the results obtained by the various investigations, it being noted that the range in this physical property is quite large.

LAWFUL WORKING UNIT STRESSES FOR YELLOW PINE

(Pounds per square inch)

The specified requirements of the Building Codes of the cities given below (Dec. 1915).

FOR BEAMS

	Extreme Fibre Stress	Compression with grain	Compression across grain	Shear with grain	Shear across grain
Albany	1200	1000	600	70	500
Atlanta	1200	1000	600	70	500
Cincinnati	1200	1000	600	70	500
Dist. of Columbia	1200	1000	600	70	500
New York	1600	1000	600	120	350
Richmond	1200	1000	600	70	500
Baltimore	1800	1000	600	100	500
Birmingham	1260	1000	600	120	500
Boston	1500	....	500	100	...
Buffalo	1800	....	...	...	...
New Haven	1800	....	...	...	...
Chicago, longleaf	1300	1100	250	130	...
Chicago, shortleaf	1000	800	250	120	...
Detroit	1250	....	...	...	100
Evansville	1200	1000	400	80	...
Louisville	1200	1000	600	80	400
Memphis	1200	1200	350	150	1000
Milwaukee, longleaf	1800	1500	350	175	1250
Milwaukee, shortleaf	1500	1200	300	150	1000
Minneapolis	1200	....	...	...	...
Trenton	1600	....	...	...	...
Paterson	1500	1500	600	70	500
New Orleans, longleaf.	1500	....	500	70	...
New Orleans, shortleaf.	1200	....	400	65	...
Philadelphia	1600	750	550	100	750
Saint Paul	1200	1100	600	70	500
Newark	1500	1500	600	70	500

LAWFUL WORKING UNIT STRESSES FOR YELLOW PINE

(Pounds per square inch)

The specified requirements of the Building Codes of the cities given below (Dec. 1915).

FOR COLUMNS

l = effective length of column in inches.
d = least side or diameter in inches.

Albany	$l/d = 10.$	820 pounds per square inch.
Atlanta	$l/d = 12.$	784 pounds per square inch.
Dist. of Columbia	$l/d = 15.$	730 pounds per square inch.
Paterson	$l/d = 20.$	640 pounds per square inch.
Richmond	$l/d = 25.$	550 pounds per square inch.
Newark	$l/d = 30.$	460 pounds per square inch.
New York	l/d less than 10.	1200 pounds per square inch.
New York	l/d between 10 and 30.	$1400—20l/d.$
Baltimore	$l/d = 12.$	1000 pounds per square inch.
	$l/d = 24.$	875 pounds per square inch.
	$l/d = 36.$	750 pounds per square inch.
Boston	$l/d = 10.$	900 pounds per square inch.
New Orleans (for longleaf)	$l/d = 15.$	850 pounds per square inch.
	$l/d = 20.$	800 pounds per square inch.
	$l/d = 25.$	750 pounds per square inch.
	$l/d = 30.$	700 pounds per square inch.
New Orleans (for shortleaf)	$l/d = 10.$	750 pounds per square inch.
	$l/d = 15.$	710 pounds per square inch.
	$l/d = 20.$	655 pounds per square inch.
	$l/d = 25.$	615 pounds per square inch.
	$l/d = 30.$	575 pounds per square inch.
Birmingham	$1060—20l/d.$	
Chicago, longleaf	$1100\ (1—l/80d).$	
Chicago, shortleaf	$800\ (1—l/80d).$	
Milwaukee, longleaf	$1500\ (1—l/60d).$	
Milwaukee, shortleaf	$1200\ (1—l/60d).$	
Saint Paul	$1100\ (1—l/80d).$	
Memphis	$1200—15l/d.$	
Philadelphia	$750—750l/100d.$	
Buffalo, Detroit, Evansville, Louisville, Minneapolis, Cincinnati	l/d less than 12.	1000 pounds per square inch.
	l/d greater than 12.	$1000—10l/d.$

SOUTHERN PINE ASSOCIATION.

WEIGHTS OF SOUTHERN YELLOW PINE WHEN WORKED TO STANDARD SIZE

Long Leaf DRY		Short Leaf DRY	
Flooring, $\frac{13}{16}$x2¼	2000	Flooring, $\frac{13}{16}$x2¼	1800
Flooring, $\frac{13}{16}$x3¼	2200	Flooring, $\frac{13}{16}$x3¼	2000
Flooring, $\frac{13}{16}$x5¼	2400	Flooring, $\frac{13}{16}$x5¼	2200
Ceiling, $\frac{3}{8}$	1000	Ceiling, $\frac{3}{8}$	900
Ceiling, ½	1200	Ceiling, ½	1100
Ceiling, $\frac{5}{8}$	1500	Ceiling, $\frac{5}{8}$	1400
Ceiling, ¾	1800	Ceiling, ¾	1700
Partition, ¾	1900	Partition, ¾	1800
Siding, from inch stock	1100	Siding, from inch stock	1000
Siding, from 1¼ inch stock	1400	Siding, from 1¼ inch stock	1250
Drop Siding to ¾	1900	Drop Siding, ¾ and Moulded Casing	1800
Moulded Casing, 4½ to 5½	2000	Moulded Base	2000
Moulded Base, from 8, 10, 12 inch stock	2100	Finish, inch, S 1 S or S 2 S	2500
Finish, inch S 1 S or S 2 S to $\frac{13}{16}$	2600	Finish, 1¼, 1½ and 2 inch, S 1 S or S 2 S	2700
Finish, 1¼, 1½ and 2 inch, S 1 S or S 2 S to Standard Thickness	2800	Finish, 1, 1¼, 1½ and 2 inch, rough	3200
Finish, 1, 1¼, 1½ and 2 inch, rough	3400		
SHIPPING DRY		**SHIPPING DRY**	
Shiplap and D. & M. ¾	2400	Shiplap and D. & M. ¾	2200
Grooved Roofing $\frac{13}{16}$	2600	Grooved Roofing	2400
Com. Boards and Fencing, 1x4, 6, 8 or 10 inch, S 1 S or 2 S $\frac{13}{16}$	2700	Com. Boards and Fencing, 1x4, 6, 8, 10 inch, S 1 S or 2 S to $\frac{13}{16}$	2500
Com. Boards, 1x12 S 1 S or 2 S to $\frac{13}{16}$	2800	Com. Boards, 1x12, S 1 S or 2 S to $\frac{13}{16}$	2600
Com. Boards and Fencing, 1x4, 6, 8 or 10 inch, rough	3400	Com. Boards and Fencing, 1x4, 6, 8, 10 inch, rough.	3300
Com. Boards, 1x12, rough	3500	Com. Boards, 1x12, rough	3400
2x4, 2x6 and 2x8, S 1 S 1 E to 1⅝	2700	2x4, 2x6 and 2x8, S 1 S 1 E to 1⅝	2500
2x4, 2x6 and 2x8, rough	3400	2x4, 2x6 and 2x8, rough	3300
2x10 and 2x12, S 1 S 1 E to 1⅝	2800	2x10 and 2x12, S 1 S 1 E to 1⅝	2600
2x10 and 2x12, rough	3500	2x10 and 2x12, rough	3300
GREEN		**GREEN**	
2x14 and 3x12, S 1 S 1 E	3800	2x14 and 3x12, S 1 S 1 E	3500
2x14 and 3x12, rough	4500	2x14 and 3x12, rough	4200
4x4 and 6x6, S 1 S 1 E	3800	3x4 and 6x6, S 1 S 1 E	3500
4x4 and 6x6, rough	4500	4x4 and 6x8, rough	4200
6x8 and over, rough	4500	8x8 and over, rough	4200
6x8 and over, S 4 S	3800		
Plastering Lath, dry	550	Plastering Lath, dry	500
Byrkit Lath, dry	1800	Byrkit Lath, dry	1650

For Hollow Back Flooring, Ceiling and Drop Siding Deduct 100 lbs.

TABLE OF BOARD MEASURE

Width in Inches	THICKNESS IN INCHES									Width in Inches
	1	1¼	1½	1¾	2	2¼	2½	2¾	3	
	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	
¼	.0208	.0260	.0313	.0365	.0417	.0469	.0521	.0573	.0625	¼
½	.0417	.0521	.0625	.0729	.0833	.0938	.1042	.1146	.1250	½
¾	.0625	.0781	.0938	.1094	.1250	.1406	.1563	.1719	.1875	¾
1	.0833	.1042	.1250	.1458	.1667	.1875	.2083	.2292	.2500	1
¼	.1042	.1302	.1563	.1823	.2083	.2344	.2604	.2865	.3125	¼
½	.1250	.1563	.1875	.2188	.2500	.2813	.3125	.3438	.3750	½
¾	.1458	.1823	.2187	.2552	.2917	.3281	.3646	.4010	.4375	¾
2	.1667	.2083	.2500	.2917	.3333	.3750	.4166	.4583	.5000	2
¼	.1875	.2344	.2813	.3281	.3750	.4219	.4688	.5156	.5625	¼
½	.2083	.2604	.3125	.3646	.4167	.4688	.5208	.5729	.6250	½
¾	.2292	.2865	.3438	.4010	.4583	.5156	.5729	.6302	.6875	¾
3	.2500	.3125	.3750	.4375	.5000	.5625	.6250	.6875	.7500	3
¼	.2708	.3385	.4063	.4739	.5416	.6094	.6771	.7448	.8125	¼
½	.2917	.3646	.4375	.5104	.5833	.6563	.7292	.8021	.8750	½
¾	.3125	.3906	.4689	.5469	.6250	.7031	.7813	.8594	.9375	¾
4	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167	1.000	4
¼	.3542	.4427	.5312	.6198	.7083	.7969	.8854	.9740	1.063	¼
½	.3750	.4688	.5625	.6563	.7500	.8438	.9375	1.031	1.125	½
¾	.3958	.4948	.5938	.6927	.7917	.8906	.9896	1.086	1.188	¾
5	.4167	.5208	.6250	.7292	.8333	.9375	1.042	1.146	1.250	5
¼	.4375	.5469	.6563	.7656	.8750	.9844	1.094	1.203	1.313	¼
½	.4583	.5729	.6875	.8020	.9167	1.031	1.146	1.260	1.375	½
¾	.4792	.5990	.7188	.8385	.9583	1.078	1.198	1.318	1.438	¾
6	.5000	.6250	.7500	.8750	1.000	1.125	1.250	1.375	1.500	6
¼	.5208	.6510	.7813	.9115	1.042	1.172	1.302	1.432	1.563	¼
½	.5417	.6771	.8125	.9479	1.083	1.219	1.354	1.490	1.625	½
¾	.5625	.7031	.8438	.9844	1.125	1.266	1.406	1.547	1.688	¾
7	.5833	.7292	.8750	1.021	1.167	1.312	1.458	1.604	1.750	7
¼	.6042	.7552	.9063	1.057	1.208	1.359	1.510	1.661	1.813	¼
½	.6250	.7813	.9375	1.094	1.250	1.406	1.563	1.719	1.875	½
¾	.6458	.8073	.9688	1.130	1.292	1.453	1.615	1.776	1.938	¾
8	.6667	.8333	1.000	1.167	1.333	1.500	1.667	1.833	2.000	8
¼	.6875	.8594	1.031	1.203	1.375	1.547	1.719	1.891	2.063	¼
½	.7083	.8854	1.063	1.240	1.417	1.594	1.771	1.948	2.125	½
¾	.7292	.9114	1.094	1.276	1.458	1.641	1.823	2.005	2.188	¾
9	.7500	.9375	1.125	1.313	1.500	1.688	1.875	2.062	2.250	9
¼	.7708	.9635	1.156	1.349	1.542	1.734	1.927	2.120	2.313	¼
½	.7917	.9895	1.188	1.385	1.583	1.781	1.979	2.177	2.375	½
¾	.8125	1.016	1.219	1.422	1.625	1.828	2.031	2.234	2.438	¾
10	.8333	1.042	1.250	1.458	1.667	1.875	2.083	2.292	2.500	10
¼	.8542	1.068	1.281	1.495	1.708	1.922	2.135	2.349	2.563	¼
½	.8750	1.094	1.313	1.531	1.750	1.969	2.188	2.406	2.625	½
¾	.8958	1.120	1.344	1.568	1.792	2.016	2.240	2.463	2.688	¾
11	.9167	1.146	1.375	1.604	1.833	2.063	2.292	2.521	2.750	11
¼	.9375	1.172	1.406	1.641	1.875	2.109	2.344	2.578	2.813	¼
½	.9583	1.198	1.438	1.677	1.917	2.156	2.396	2.635	2.875	½
¾	.9792	1.224	1.469	1.714	1.958	2.203	2.448	2.693	2.938	¾
12	1.000	1.250	1.500	1.750	2.000	2.250	2.500	2.750	3.000	12
½	1.042	1.302	1.563	1.823	2.083	2.344	2.604	2.865	3.125	½
13	1.083	1.354	1.625	1.896	2.167	2.438	2.708	2.979	3.250	13
½	1.125	1.406	1.688	1.969	2.250	2.531	2.813	3.094	3.375	½
14	1.167	1.458	1.750	2.042	2.333	2.625	2.917	3.208	3.500	14
½	1.208	1.510	1.813	2.115	2.417	2.719	3.021	3.322	3.625	½
15	1.250	1.563	1.875	2.188	2.500	2.813	3.125	3.438	3.750	15
½	1.292	1.615	1.938	2.260	2.583	2.906	3.229	3.552	3.875	½
16	1.333	1.667	2.000	2.333	2.667	3.000	3.333	3.667	4.000	16
½	1.375	1.719	2.063	2.406	2.750	3.094	3.438	3.781	4.125	½
17	1.417	1.771	2.125	2.479	2.833	3.188	3.542	3.896	4.250	17
½	1.458	1.823	2.187	2.552	2.917	3.281	3.646	4.010	4.375	½
18	1.500	1.875	2.250	2.625	3.000	3.375	3.750	4.125	4.500	18
19	1.583	1.979	2.375	2.771	3.167	3.563	3.958	4.354	4.750	19
20	1.667	2.083	2.500	2.917	3.333	3.750	4.167	4.583	5.000	20
21	1.750	2.188	2.625	3.063	3.500	3.938	4.375	4.812	5.250	21
22	1.833	2.292	2.750	3.208	3.667	4.125	4.583	5.042	5.500	22
23	1.917	2.396	2.875	3.354	3.833	4.313	4.792	5.270	5.750	23
24	2.000	2.500	3.000	3.500	4.000	4.500	5.000	5 500	6.000	24

TABLE OF BOARD MEASURE

CONTINUED

Width in Inches	THICKNESS IN INCHES									Width in Inches
	3¼	3½	3¾	4	4¼	4½	4¾	5	5¼	
	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	
¼	.0677	.0729	.0781	.0833	.0885	.0938	.0990	.1042	.1094	¼
½	.1354	.1457	.1562	.1667	.1770	.1875	.1979	.2083	.2188	½
¾	.2031	.2187	.2344	.2500	.2656	.2813	.2969	.3125	.3281	¾
1	.2708	.2917	.3125	.3333	.3542	.3750	.3958	.4167	.4375	1
¼	.3385	.3646	.3906	.4167	.4427	.4688	.4948	.5208	.5469	¼
½	.4063	.4375	.4688	.5000	.5313	.5625	.5938	.6250	.6563	½
¾	.4740	.5104	.5469	.5833	.6198	.6563	.6927	.7292	.7656	¾
2	.5417	.5833	.6250	.6667	.7083	.7500	.7917	.8333	.8750	2
¼	.6094	.6563	.7031	.7500	.7969	.8438	.8906	.9375	.9844	¼
½	.6771	.7292	.7813	.8333	.8854	.9375	.9896	1.042	1.094	½
¾	.7448	.8021	.8594	.9167	.9740	1.031	1.089	1.146	1.203	¾
3	.8125	.8750	.9375	1.000	1.062	1.125	1.188	1.250	1.313	3
¼	.8802	.9479	1.016	1.083	1.151	1.219	1.286	1.354	1.422	¼
½	.9479	1.021	1.094	1.167	1.240	1.313	1.385	1.458	1.531	½
¾	1.016	1.094	1.172	1.250	1.327	1.406	1.484	1.563	1.641	¾
4	1.083	1.167	1.250	1.333	1.416	1.500	1.583	1.667	1.750	4
¼	1.151	1.240	1.328	1.417	1.504	1.594	1.682	1.771	1.859	¼
½	1.219	1.313	1.406	1.500	1.593	1.688	1.781	1.875	1.969	½
¾	1.286	1.384	1.484	1.583	1.681	1.781	1.880	1.979	2.078	¾
5	1.354	1.457	1.566	1.666	1.770	1.875	1.979	2.083	2.188	5
¼	1.422	1.530	1.644	1.750	1.858	1.969	2.078	2.188	2.297	¼
½	1.490	1.603	1.722	1.833	1.947	2.063	2.177	2.292	2.406	½
¾	1.557	1.676	1.800	1.917	2.035	2.156	2.276	2.396	2.516	¾
6	1.625	1.750	1.875	2.000	2.125	2.250	2.375	2.500	2.625	6
¼	1.693	1.823	1.953	2.083	2.214	2.344	2.474	2.604	2.734	¼
½	1.760	1.896	2.031	2.167	2.302	2.438	2.573	2.708	2.843	½
¾	1.828	1.969	2.109	2.250	2.391	2.531	2.672	2.813	2.953	¾
7	1.896	2.042	2.188	2.333	2.479	2.625	2.771	2.917	3.063	7
¼	1.964	2.115	2.266	2.416	2.568	2.719	2.870	3.021	3.172	¼
½	2.031	2.187	2.344	2.500	2.656	2.813	2.969	3.125	3.281	½
¾	2.099	2.260	2.422	2.583	2.745	2.906	3.068	3.229	3.391	¾
8	2.167	2.333	2.500	2.667	2.833	3.000	3.167	3.333	3.500	8
¼	2.234	2.406	2.578	2.750	2.922	3.094	3.266	3.438	3.609	¼
½	2.302	2.479	2.656	2.833	3.010	3.188	3.365	3.542	3.718	½
¾	2.370	2.552	2.734	2.916	3.099	3.281	3.464	3.646	3.828	¾
9	2.438	2.625	2.813	3.000	3.187	3.375	3.563	3.750	3.938	9
¼	2.505	2.698	2.891	3.083	3.276	3.469	3.661	3.854	4.047	¼
½	2.573	2.771	2.969	3.167	3.365	3.563	3.760	3.958	4.156	½
¾	2.641	2.844	3.047	3.250	3.453	3.656	3.859	4.063	4.266	¾
10	2.708	2.917	3.125	3.333	3.542	3.750	3.958	4.167	4.375	10
¼	2.776	2.990	3.203	3.416	3.630	3.844	4.057	4.271	4.484	¼
½	2.844	3.063	3.281	3.500	3.719	3.938	4.156	4.375	4.594	½
¾	2.911	3.135	3.359	3.583	3.807	4.031	4.255	4.479	4.703	¾
11	2.979	3.208	3.438	3.666	3.896	4.125	4.354	4.583	4.813	11
¼	3.047	3.281	3.516	3.750	3.984	4.219	4.453	4.688	4.922	¼
½	3.115	3.354	3.594	3.833	4.073	4.313	4.552	4.792	5.031	½
¾	3.182	3.427	3.672	3.916	4.161	4.406	4.651	4.896	5.141	¾
12	3.250	3.500	3.750	4.000	4.250	4.500	4.750	5.000	5.250	12
½	3.385	3.646	3.906	4.167	4.427	4.688	4.948	5.208	5.469	½
13	3.521	3.792	4.063	4.333	4.604	4.875	5.146	5.417	5.688	13
½	3.656	3.938	4.219	4.500	4.781	5.063	5.344	5.625	5.906	½
14	3.792	4.083	4.375	4.667	4.958	5.250	5.542	5.833	6.125	14
½	3.927	4.229	4.531	4.833	5.135	5.438	5.740	6.042	6.344	½
15	4.063	4.375	4.688	5.000	5.313	5.625	5.938	6.250	6.563	15
½	4.198	4.521	4.844	5.166	5.490	5.813	6.135	6.458	6.781	½
16	4.333	4.667	5.000	5.333	5.667	6.000	6.333	6.667	7.000	16
½	4.469	4.813	5.156	5.500	5.844	6.188	6.531	6.875	7.219	½
17	4.604	4.958	5.313	5.667	6.021	6.375	6.729	7.083	7.438	17
½	4.740	5.104	5.469	5.833	6.198	6.563	6.927	7.292	7.656	½
18	4.875	5.250	5.625	6.000	6.375	6.750	7.125	7.500	7.875	18
19	5.146	5.542	5.938	6.333	6.729	7.125	7.521	7.917	8.313	19
20	5.417	5.833	6.250	6.667	7.083	7.500	7.917	8.333	8.750	20
21	5.688	6.125	6.563	7.000	7.438	7.875	8.313	8.750	9.188	21
22	5.958	6.417	6.875	7.333	7.792	8.250	8.708	9.167	9.625	22
23	6.229	6.708	7.188	7.667	8.145	8.625	9.104	9.583	10.06	23
24	6.500	7.000	7.500	8.000	8.500	9.000	9.500	10.00	10.50	24

TABLE OF BOARD MEASURE

CONTINUED

Width in Inches	THICKNESS IN INCHES									Width in Inches
	5½	5¾	6	6¼	6½	6¾	7	7¼	7½	
	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	
¼	.1146	.1198	.1250	.1302	.1354	.1406	.1458	.1510	.1563	¼
½	.2292	.2396	.2500	.2604	.2708	.2813	.2917	.3021	.3125	½
¾	.3438	.3594	.3750	.3906	.4063	.4219	.4375	.4531	.4688	¾
1	.4583	.4792	.5000	.5208	.5417	.5625	.5833	.6042	.6250	1
¼	.5729	.5990	.6250	.6510	.6771	.7031	.7292	.7552	.7813	¼
½	.6875	.7188	.7500	.7812	.8125	.8438	.8750	.9062	.9375	½
¾	.8021	.8385	.8750	.9115	.9479	.9844	1.020	1.057	1.094	¾
2	.9167	.9583	1.000	1.042	1.083	1.125	1.167	1.208	1.250	2
¼	1.031	1.078	1.125	1.172	1.219	1.266	1.313	1.359	1.406	¼
½	1.146	1.198	1.250	1.302	1.354	1.406	1.458	1.510	1.563	½
¾	1.260	1.318	1.375	1.432	1.490	1.547	1.604	1.661	1.719	¾
3	1.375	1.438	1.500	1.562	1.625	1.688	1.750	1.813	1.875	3
¼	1.490	1.557	1.625	1.693	1.760	1.828	1.896	1.964	2.031	¼
½	1.604	1.677	1.750	1.823	1.896	1.969	2.042	2.115	2.188	½
¾	1.719	1.797	1.875	1.953	2.031	2.109	2.188	2.266	2.344	¾
4	1.833	1.917	2.000	2.083	2.167	2.250	2.333	2.417	2.500	4
¼	1.948	2.036	2.125	2.214	2.302	2.391	2.479	2.568	2.656	¼
½	2.063	2.156	2.250	2.344	2.438	2.531	2.625	2.719	2.813	½
¾	2.177	2.276	2.375	2.474	2.573	2.672	2.771	2.870	2.969	¾
5	2.292	2.396	2.500	2.604	2.708	2.813	2.917	3.021	3.125	5
¼	2.406	2.516	2.625	2.734	2.844	2.953	3.063	3.172	3.281	¼
½	2.521	2.635	2.750	2.865	2.979	3.094	3.208	3.323	3.438	½
¾	2.635	2.755	2.875	2.995	3.115	3.234	3.354	3.474	3.594	¾
6	2.750	2.875	3.000	3.125	3.250	3.375	3.500	3.625	3.750	6
¼	2.865	2.995	3.125	3.255	3.385	3.516	3.646	3.776	3.906	¼
½	2.979	3.115	3.250	3.385	3.521	3.656	3.792	3.927	4.063	½
¾	3.094	3.234	3.375	3.516	3.656	3.797	3.938	4.078	4.219	¾
7	3.208	3.354	3.500	3.646	3.792	3.938	4.083	4.229	4.375	7
¼	3.323	3.474	3.625	3.776	3.927	4.078	4.229	4.380	4.531	¼
½	3.438	3.594	3.750	3.906	4.063	4.219	4.375	4.531	4.688	½
¾	3.552	3.714	3.875	4.036	4.198	4.359	4.521	4.682	4.844	¾
8	3.667	3.833	4.000	4.167	4.333	4.500	4.667	4.833	5.000	8
¼	3.781	3.953	4.125	4.297	4.469	4.641	4.813	4.984	5.156	¼
½	3.896	4.073	4.250	4.427	4.604	4.781	4.957	5.135	5.313	½
¾	4.010	4.193	4.375	4.557	4.740	4.922	5.103	5.286	5.469	¾
9	4.125	4.313	4.500	4.687	4.875	5.063	5.249	5.438	5.625	9
¼	4.240	4.432	4.625	4.818	5.010	5.203	5.395	5.589	5.781	¼
½	4.354	4.552	4.750	4.948	5.146	5.344	5.541	5.740	5.938	½
¾	4.469	4.672	4.875	5.078	5.281	5.484	5.687	5.891	6.094	¾
10	4.583	4.792	5.000	5.208	5.417	5.625	5.833	6.042	6.250	10
¼	4.698	4.911	5.125	5.339	5.552	5.766	5.979	6.193	6.406	¼
½	4.813	5.031	5.250	5.469	5.688	5.906	6.125	6.344	6.563	½
¾	4.927	5.151	5.375	5.599	5.823	6.047	6.271	6.495	6.719	¾
11	5.042	5.271	5.500	5.729	5.958	6.188	6.417	6.646	6.876	11
¼	5.156	5.391	5.625	5.859	6.094	6.328	6.563	6.797	7.031	¼
½	5.271	5.510	5.750	5.990	6.229	6.469	6.708	6.948	7.188	½
¾	5.385	5.630	5.875	6.120	6.365	6.609	6.854	7.099	7.344	¾
12	5.500	5.750	6.000	6.250	6.500	6.750	7.000	7.250	7.500	12
½	5.729	5.990	6.250	6.510	6.771	7.031	7.292	7.552	7.813	½
13	5.958	6.229	6.500	6.771	7.042	7.313	7.583	7.854	8.125	13
½	6.188	6.469	6.750	7.031	7.313	7.594	7.875	8.156	8.438	½
14	6.417	6.708	7.000	7.292	7.583	7.875	8.167	8.458	8.750	14
½	6.646	6.948	7.250	7.552	7.854	8.156	8.458	8.760	9.063	½
15	6.875	7.188	7.500	7.812	8.125	8.438	8.750	9.063	9.375	15
½	7.104	7.427	7.750	8.073	8.396	8.719	9.042	9.365	9.688	½
16	7.333	7.667	8.000	8.333	8.667	9.000	9.333	9.667	10.00	16
½	7.563	7.906	8.250	8.594	8.938	9.281	9.625	9.969	10.31	½
17	7.792	8.146	8.500	8.854	9.208	9.563	9.917	10.27	10.63	17
½	8.021	8.385	8.750	9.115	9.479	9.844	10.21	10.57	10.94	½
18	8.250	8.625	9.000	9.375	9.750	10.13	10.50	10.88	11.25	18
19	8.708	9.104	9.500	9.896	10.29	10.69	11.08	11.48	11.88	19
20	9.167	9.583	10.00	10.42	10.83	11.25	11.67	12.08	12.50	20
21	9.625	10.06	10.50	10.94	11.38	11.81	12.25	12.69	13.13	21
22	10.08	10.54	11.00	11.46	11.92	12.38	12.83	13.29	13.75	22
23	10.54	11.02	11.50	11.98	12.46	12.94	13.42	13.90	14.38	23
24	11.00	11.50	12.00	12.50	13.00	13.50	14.00	14.50	15.00	24

TABLE OF BOARD MEASURE

CONTINUED

Width in Inches	THICKNESS IN INCHES									Width in Inches
	7¾	8	8¼	8½	8¾	9	9¼	9½	9¾	
	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	
¼	.1615	.1667	.1719	.1771	.1823	.1875	.1927	.1979	.2031	¼
½	.3229	.3333	.3438	.3542	.3646	.3750	.3854	.3958	.4063	½
¾	.4844	.5000	.5156	.5313	.5467	.5625	.5781	.5938	.6094	¾
1	.6458	.6667	.6875	.7083	.7292	.7500	.7708	.7917	.8125	1
¼	.8073	.8333	.8594	.8854	.9115	.9375	.9635	.9896	1.016	¼
½	.9688	1.000	1.031	1.063	1.094	1.125	1.156	1.188	1.219	½
¾	1.130	1.167	1.203	1.240	1.276	1.313	1.349	1.385	1.422	¾
2	1.292	1.333	1.375	1.417	1.458	1.500	1.542	1.583	1.625	2
¼	1.453	1.500	1.547	1.594	1.641	1.688	1.734	1.781	1.828	¼
½	1.615	1.667	1.719	1.771	1.822	1.875	1.927	1.979	2.031	½
¾	1.776	1.833	1.891	1.948	2.005	2.063	2.120	2.177	2.234	¾
3	1.938	2.000	2.063	2.125	2.188	2.250	2.313	2.375	2.438	3
¼	2.099	2.167	2.234	2.302	2.370	2.438	2.505	2.573	2.641	¼
½	2.260	2.333	2.406	2.479	2.552	2.625	2.698	2.771	2.844	½
¾	2.422	2.500	2.578	2.656	2.734	2.813	2.891	2.969	3.047	¾
4	2.583	2.667	2.750	2.833	2.917	3.000	3.083	3.167	3.250	4
¼	2.745	2.833	2.922	3.010	3.099	3.188	3.276	3.365	3.453	¼
½	2.906	3.000	3.094	3.188	3.281	3.375	3.469	3.563	3.656	½
¾	3.068	3.167	3.266	3.365	3.464	3.563	3.661	3.760	3.859	¾
5	3.229	3.333	3.438	3.542	3.646	3.750	3.854	3.958	4.063	5
¼	3.391	3.500	3.609	3.719	3.828	3.938	4.047	4.156	4.266	¼
½	3.552	3.667	3.781	3.896	4.010	4.125	4.240	4.354	4.469	½
¾	3.714	3.833	3.953	4.073	4.193	4.313	4.432	4.552	4.672	¾
6	3.875	4.000	4.125	4.250	4.375	4.500	4.625	4.750	4.875	6
¼	4.036	4.167	4.297	4.427	4.557	4.688	4.818	4.948	5.078	¼
½	4.198	4.333	4.469	4.604	4.740	4.875	5.010	5.146	5.281	½
¾	4.359	4.500	4.641	4.781	4.922	5.063	5.203	5.344	5.484	¾
7	4.521	4.667	4.813	4.958	5.104	5.250	5.360	5.542	5.688	7
¼	4.682	4.833	4.984	5.135	5.286	5.438	5.590	5.740	5.891	¼
½	4.844	5.000	5.156	5.313	5.469	5.625	5.782	5.938	6.094	½
¾	5.005	5.167	5.328	5.490	5.651	5.813	5.975	6.135	6.297	¾
8	5.167	5.333	5.500	5.667	5.833	6.000	6.167	6.333	6.500	8
¼	5.328	5.500	5.672	5.844	6.016	6.188	6.359	6.531	6.703	¼
½	5.490	5.667	5.844	6.021	6.198	6.375	6.552	6.729	6.906	½
¾	5.651	5.833	6.016	6.198	6.380	6.563	6.745	6.927	7.109	¾
9	5.813	6.000	6.188	6.375	6.563	6.750	6.938	7.125	7.313	9
¼	5.974	6.167	6.359	6.552	6.745	6.938	7.130	7.323	7.516	¼
½	6.135	6.333	6.531	6.729	6.927	7.125	7.323	7.521	7.719	½
¾	6.297	6.500	6.703	6.906	7.109	7.313	7.516	7.719	7.922	¾
10	6.458	6.667	6.875	7.083	7.292	7.500	7.708	7.917	8.125	10
¼	6.620	6.833	7.047	7.260	7.474	7.688	7.901	8.115	8.328	¼
½	6.781	7.000	7.219	7.438	7.656	7.875	8.094	8.313	8.531	½
¾	6.943	7.167	7.391	7.615	7.839	8.063	8.286	8.510	8.734	¾
11	7.104	7.333	7.563	7.792	8.021	8.250	8.479	8.708	8.938	11
¼	7.266	7.500	7.735	7.969	8.203	8.438	8.672	8.906	9.141	¼
½	7.427	7.667	7.906	8.146	8.386	8.625	8.865	9.104	9.344	½
¾	7.589	7.833	8.078	8.323	8.568	8.813	9.057	9.302	9.547	¾
12	7.750	8.000	8.250	8.500	8.750	9.000	9.250	9.500	9.750	12
½	8.073	8.333	8.594	8.854	9.115	9.375	9.635	9.896	10.16	½
13	8.396	8.666	8.938	9.208	9.479	9.750	10.02	10.29	10.56	13
½	8.719	9.000	9.281	9.563	9.844	10.13	10.41	10.69	10.97	½
14	9.042	9.333	9.625	9.917	10.21	10.50	10.79	11.08	11.38	14
½	9.365	9.666	9.969	10.27	10.57	10.88	11.18	11.48	11.78	½
15	9.688	10.00	10.31	10.63	10.94	11.25	11.56	11.88	12.19	15
½	10.01	10.33	10.66	10.98	11.30	11.63	11.95	12.27	12.59	½
16	10.33	10.67	11.00	11.33	11.67	12.00	12.33	12.67	13.00	16
½	10.66	11.00	11.34	11.69	12.03	12.38	12.72	13.06	13.41	½
17	10.98	11.33	11.69	12.04	12.40	12.75	13.10	13.46	13.81	17
½	11.30	11.66	12.03	12.40	12.76	13.13	13.49	13.85	14.22	½
18	11.63	12.00	12.38	12.75	13.13	13.50	13.88	14.25	14.63	18
19	12.27	12.67	13.06	13.46	13.85	14.25	14.65	15.04	15.44	19
20	12.92	13.33	13.75	14.17	14.58	15.00	15.42	15.83	16.25	20
21	13.56	14.00	14.44	14.88	15.31	15.75	16.19	16.63	17.06	21
22	14.21	14.66	15.13	15.58	16.04	16.50	16.96	17.42	17.88	22
23	14.85	15.33	15.81	16.29	16.77	17.25	17.73	18.21	18.69	23
24	15.50	16.00	16.50	17.00	17.50	18.00	18.50	19.00	19.50	24

TABLE OF BOARD MEASURE

CONTINUED

Width in Inches	THICKNESS IN INCHES									Width in Inches
	10	10¼	10½	10¾	11	11¼	11½	11¾	12	
	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	Ft. Bd. M.	
¼	.2083	.2135	.2188	.2240	.2292	.2344	.2396	.2448	.2500	¼
½	.4167	.4271	.4375	.4479	.4583	.4688	.4792	.4896	.5000	½
¾	.6250	.6406	.6563	.6719	.6875	.7031	.7188	.7344	.7500	¾
1	.8333	.8542	.8750	.8958	.9167	.9375	.9583	.9792	1.000	1
¼	1.042	1.068	1.094	1.120	1.146	1.172	1.198	1.224	1.250	¼
½	1.250	1.821	1.313	1.344	1.375	1.406	1.438	1.469	1.500	½
¾	1.458	1.495	1.531	1.568	1.604	1.641	1.677	1.714	1.750	¾
2	1.667	1.708	1.750	1.792	1.833	1.875	1.917	1.958	2.000	2
¼	1.875	1.922	1.969	2.016	2.063	2.109	2.156	2.203	2.250	¼
½	2.083	2.135	2.188	2.240	2.292	2.344	2.396	2.448	2.500	½
¾	2.292	2.349	2.406	2.464	2.521	2.578	2.635	2.693	2.750	¾
3	2.500	2.563	2.625	2.688	2.750	2.813	2.875	2.938	3.000	3
¼	2.708	2.776	2.844	2.911	2.979	3.047	3.115	3.182	3.250	¼
½	2.917	2.990	3.063	3.135	3.208	3.281	3.354	3.427	3.500	½
¾	3.125	3.203	3.281	3.359	3.438	3.516	3.594	3.672	3.750	¾
4	3.333	3.417	3.500	3.583	3.667	3.750	3.833	3.917	4.000	4
¼	3.542	3.630	3.719	3.807	3.896	3.984	4.073	4.161	4.250	¼
½	3.750	3.844	3.938	4.031	4.125	4.219	4.313	4.406	4.500	½
¾	3.958	4.057	4.156	4.255	4.354	4.453	4.552	4.651	4.750	¾
5	4.167	4.271	4.375	4.479	4.583	4.688	4.791	4.896	5.000	5
¼	4.375	4.484	4.594	4.703	4.813	4.922	5.031	5.141	5.250	¼
½	4.583	4.698	4.813	4.927	5.042	5.156	5.270	5.385	5.500	½
¾	4.792	4.911	5.031	5.151	5.271	5.391	5.510	5.630	5.750	¾
6	5.000	5.125	5.250	5.375	5.500	5.625	5.750	5.875	6.000	6
¼	5.208	5.339	5.469	5.599	5.729	5.859	5.990	6.120	6.250	¼
½	5.417	5.552	5.688	5.823	5.958	6.094	6.229	6.365	6.500	½
¾	5.625	5.766	5.906	6.047	6.188	6.328	6.469	6.609	6.750	¾
7	5.833	5.979	6.125	6.271	6.417	6.563	6.708	6.854	7.000	7
¼	6.042	6.193	6.344	6.495	6.646	6.797	6.948	7.099	7.250	¼
½	6.250	6.406	6.563	6.719	6.875	7.031	7.188	7.344	7.500	½
¾	6.458	6.620	6.781	6.943	7.104	7.266	7.427	7.589	7.750	¾
8	6.667	6.833	7.000	7.167	7.333	7.500	7.667	7.833	8.000	8
¼	6.875	7.047	7.219	7.391	7.563	7.734	7.905	8.078	8.250	¼
½	7.083	7.260	7.438	7.615	7.792	7.969	8.146	8.323	8.500	½
¾	7.292	7.474	7.656	7.839	8.021	8.203	8.385	8.568	8.750	¾
9	7.500	7.688	7.875	8.063	8.250	8.438	8.625	8.813	9.000	9
¼	7.708	7.901	8.094	8.286	8.479	8.672	8.865	9.057	9.250	¼
½	7.917	8.115	8.313	8.510	8.709	8.906	9.104	9.302	9.500	½
¾	8.125	8.328	8.531	8.734	8.939	9.141	9.344	9.547	9.750	¾
10	8.333	8.542	8.750	8.958	9.167	9.375	9.583	9.792	10.00	10
¼	8.542	8.755	8.969	9.182	9.396	9.609	9.823	10.04	10.25	¼
½	8.750	8.969	9.188	9.406	9.625	9.844	10.06	10.28	10.50	½
¾	8.958	9.182	9.406	9.630	9.854	10.08	10.30	10.53	10.75	¾
11	9.167	9.396	9.625	9.854	10.08	10.31	10.54	10.77	11.00	11
¼	9.375	9.609	9.844	10.08	10.31	10.55	10.78	11.02	11.25	¼
½	9.583	9.823	10.06	10.30	10.54	10.78	11.02	11.26	11.50	½
¾	9.792	10.04	10.28	10.53	10.77	11.02	11.26	11.51	11.75	¾
12	10.00	10.25	10.50	10.75	11.00	11.25	11.50	11.75	12.00	12
½	10.42	10.68	10.94	11.20	11.46	11.72	11.98	12.24	12.50	½
13	10.83	11.10	11.38	11.65	11.92	12.19	12.46	12.73	13.00	13
½	11.25	11.53	11.81	12.09	12.38	12.66	12.94	13.22	13.50	½
14	11.67	11.96	12.25	12.54	12.83	13.13	13.42	13.71	14.00	14
½	12.08	12.39	12.69	12.99	13.29	13.59	13.90	14.20	14.50	½
15	12.50	12.81	13.13	13.44	13.75	14.06	14.38	14.69	15.00	15
½	12.92	13.24	13.56	13.89	14.21	14.53	14.85	15.18	15.50	½
16	13.33	13.67	14.00	14.33	14.67	15.00	15.33	15.67	16.00	16
½	13.75	14.09	14.44	14.78	15.13	15.47	15.81	16.16	16.50	½
17	14.17	14.52	14.88	15.23	15.58	15.94	16.29	16.65	17.00	17
½	14.58	14.95	15.31	15.77	16.04	16.41	16.77	17.14	17.50	½
18	15.00	15.38	15.75	16.13	16.50	16.88	17.25	17.63	18.00	18
19	15.83	16.23	16.63	17.02	17.42	17.81	18.21	18.60	19.00	19
20	16.67	17.08	17.50	17.92	18.33	18.75	19.17	19.58	20.00	20
21	17.50	17.94	18.38	18.81	19.25	19.69	20.13	20.56	21.00	21
22	18.33	18.79	19.25	19.71	20.17	20.63	21.08	21.54	22.00	22
23	19.17	19.65	20.13	20.60	21.08	21.56	22.04	22.52	23.00	23
24	20.00	20.50	21.00	21.50	22.00	22.50	23.00	23.50	24.00	24

DECIMALS OF AN INCH AND OF A FOOT

Fractions of Inch or Foot		Inches equivalent to Fractions of a Ft.	Fractions of Inch or Foot		Inches equivalent to Fractions of a Ft.	Fractions of Inch or Foot		Inches equivalent to Fractions of a Ft.	Fractions of Inch or Foot		Inches equivalent to Fractions of a Ft.
	.0052	1/16		.2552	3 1/16		.5052	6 1/16		.7552	9 1/16
	.0104	1/8		.2604	3 1/8		.5104	6 1/8		.7604	9 1/8
1/64	.015625	3/16	17/64	.265625	3 3/16	33/64	.515625	6 3/16	49/64	.765625	9 3/16
	.0208	1/4		.2708	3 1/4		.5208	6 1/4		.7708	9 1/4
	.0260	5/16		.2760	3 5/16		.5260	6 5/16		.7760	9 5/16
1/32	.03125	3/8	9/32	.28125	3 3/8	17/32	.53125	6 3/8	25/32	.78125	9 3/8
	.0365	7/16		.2865	3 7/16		.5365	6 7/16		.7865	9 7/16
	.0417	1/2		.2917	3 1/2		.5417	6 1/2		.7917	9 1/2
3/64	.046875	9/16	19/64	.296875	3 9/16	35/64	.546875	6 9/16	51/64	.796875	9 9/16
	.0521	5/8		.3021	3 5/8		.5521	6 5/8		.8021	9 5/8
	.0573	11/16		.3073	3 11/16		.5573	6 11/16		.8073	9 11/16
1/16	.0625	3/4	5/16	.3125	3 3/4	9/16	.5625	6 3/4	13/16	.8125	9 3/4
	.0677	13/16		.3177	3 13/16		.5677	6 13/16		.8177	9 13/16
	.0729	7/8		.3229	3 7/8		.5729	6 7/8		.8229	9 7/8
5/64	.078125	15/16	21/64	.328125	3 15/16	37/64	.578125	6 15/16	53/64	.828125	9 15/16
	.0833	1		.3333	4		.5833	7		.8333	10
	.0885	1 1/16		.3385	4 1/16		.5885	7 1/16		.8385	10 1/16
3/32	.09375	1 1/8	11/32	.34375	4 1/8	19/32	.59375	7 1/8	27/32	.84375	10 1/8
	.0990	1 3/16		.3490	4 3/16		.5990	7 3/16		.8490	10 3/16
	.1042	1 1/4		.3542	4 1/4		.6042	7 1/4		.8542	10 1/4
7/64	.109375	1 5/16	23/64	.359375	4 5/16	39/64	.609375	7 5/16	55/64	.859375	10 5/16
	.1146	1 3/8		.3646	4 3/8		.6146	7 3/8		.8646	10 3/8
	.1198	1 7/16		.3698	4 7/16		.6198	7 7/16		.8698	10 7/16
1/8	.1250	1 1/2	3/8	.3750	4 1/2	5/8	.6250	7 1/2	7/8	.8750	10 1/2
	.1302	1 9/16		.3802	4 9/16		.6302	7 9/16		.8802	10 9/16
	.1354	1 5/8		.3854	4 5/8		.6354	7 5/8		.8854	10 5/8
9/64	.140625	1 11/16	25/64	.390625	4 11/16	41/64	.640625	7 11/16	57/64	.890625	10 11/16
	.1458	1 3/4		.3958	4 3/4		.6458	7 3/4		.8958	10 3/4
	.1510	1 13/16		.4010	4 13/16		.6510	7 13/16		.9010	10 13/16
5/32	.15625	1 7/8	13/32	.40625	4 7/8	21/32	.65625	7 7/8	29/32	.90625	10 7/8
	.1615	1 15/16		.4115	4 15/16		.6615	7 15/16		.9115	10 15/16
	.1667	2		.4167	5		.6667	8		.9167	11
11/64	.171875	2 1/16	27/64	.421875	5 1/16	43/64	.671875	8 1/16	59/64	.921875	11 1/16
	.1771	2 1/8		.4271	5 1/8		.6771	8 1/8		.9271	11 1/8
	.1823	2 3/16		.4323	5 3/16		.6823	8 3/16		.9323	11 3/16
3/16	.1875	2 1/4	7/16	.4375	5 1/4	11/16	.6875	8 1/4	15/16	.9375	11 1/4
	.1927	2 5/16		.4427	5 5/16		.6927	8 5/16		.9427	11 5/16
	.1979	2 3/8		.4479	5 3/8		.6979	8 3/8		.9479	11 3/8
13/64	.203125	2 7/16	29/64	.453125	5 7/16	45/64	.703125	8 7/16	61/64	.953125	11 7/16
	.2083	2 1/2		.4583	5 1/2		.7083	8 1/2		.9583	11 1/2
	.2135	2 9/16		.4635	5 9/16		.7135	8 9/16		.9635	11 9/16
7/32	.21875	2 5/8	15/32	.46875	5 5/8	23/32	.71875	8 5/8	31/32	.96875	11 5/8
	.2240	2 11/16		.4740	5 11/16		.7240	8 11/16		.9740	11 11/16
	.2292	2 3/4		.4792	5 3/4		.7292	8 3/4		.9792	11 3/4
15/64	.234375	2 13/16	31/64	.484375	5 13/16	47/64	.734375	8 13/16	63/64	.984375	11 13/16
	.2396	2 7/8		.4896	5 7/8		.7396	8 7/8		.9896	11 7/8
	.2448	2 15/16		.4948	5 15/16		.7448	8 15/16		.9948	11 15/16
1/4	.2500	3	1/2	.5000	6	3/4	.7500	9	1	1.0000	12

CONTENTS OF STORAGE WAREHOUSES.

MATERIAL	Weights per Cubic Foot of Space Pounds	Height of Pile Feet	Weights per Square Foot of Floor Pounds	Recommended Live Loads Pounds per Square Foot
Building Materials—				
Cement, Natural	59	6	354	300 to 400
Cement, Portland	73	6	438	
Lime and Plaster	53	5	265	
Hardware, etc.—				
Door Checks	45			300 to 400
Hinges	54			
Locks, in cases packed	31			
Sash Fasteners	48			
Screws	101			
Sheet Tin, in boxes	278	2	556	
Wire Cables, on reels			425	
Wire, Insulated Copper, in coils	63	5	315	
Wire, Galvanized Iron, in coils	74	4½	333	
Wire, Magnet, on spools	75	6	450	
Drugs, Paints, Oils, etc.—				
Alum, Pearl, in barrels	33	6	198	200 to 300
Bleaching Powder, in hogsheads	31	3½	102	
Blue Vitriol, in barrels	45	5	226	
Glycerine, in cases	52	6	312	
Linseed Oil, in iron drums	45	4	180	
Linseed Oil, in barrels	36	6	216	
Logwood Extract, in boxes	70	5	350	
Rosin, in barrels	48	6	288	
Shellac, Gum	38	6	228	
Soda Ash, in Hogsheads	62	2¾	167	
Soda, Caustic, in iron drums	88	3⅓	294	
Soda, Silicate, in barrels	53	6	318	
Sulphuric Acid	60	1⅔	100	
White Lead Paste, in cans	174	3½	610	
White Lead, dry	86	4¾	408	
Red Lead and Litharge, dry	132	3¾	495	
Miscellaneous—				
Glass in Chinaware, in crates	40	8	320	300
Hides and Leather, in bales	20	8	160	
Hides, Buffalo, in bundles	37	8	296	
Paper, Newspaper & Strawboards	35	6	210	
Paper, Writing and Calendared	60	6	360	
Rope, in coils	32	6	192	

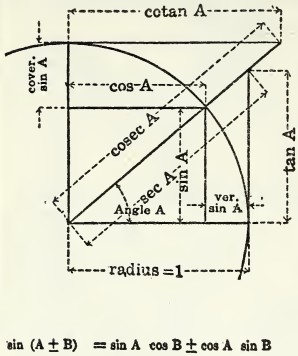
CONTENTS OF STORAGE WAREHOUSES.

MATERIAL	Weights per Cubic Foot of Space Pounds	Height of Pile Feet	Weights per Square Foot of Floor Pounds	Recommended Live Loads Pounds per Square Foot
Groceries, Wines, Liquors, etc.—				
Beans, in bags	40	8	320	
Canned Goods, in cases	58	6	348	
Coffee, Roasted, in bags	33	8	264	
Coffee, Green, in bags	39	8	312	
Dates, in cases	55	6	330	
Figs, in cases	74	5	370	
Flour, in barrels	40	5	200	
Molasses, in barrels	48	5	240	
Rice, in bags	58	6	348	250 to 300
Sal Soda, in barrels	46	5	230	
Salt, in bags	70	5	350	
Soap Powder, in cases	38	8	304	
Starch, in barrels	25	6	150	
Sugar, in cases	51	6	306	
Sugar, in barrels	43	5	215	
Tea, in chests	25	8	200	
Wines and Liquors, in barrels	38	6	228	
Dry Goods, Cotton, Wool, etc.—				
Burlap, in bales	43	6	258	
Coir Yarn, in bales	33	8	264	
Cotton, in bales, compressed	18	8	144	
Cotton Bleached Goods, in cases	28	8	224	
Cotton Flannel, in cases	12	8	96	
Cotton Sheeting, in cases	23	8	184	
Cotton Yarn, in cases	25	8	200	
Excelsior, compressed	19	8	152	
Hemp, Italian, compressed	22	8	176	
Hemp, Manila, compressed	30	8	240	200 to 250
Jute, compressed	41	8	328	
Linen Damask, in cases	50	5	250	
Linen Goods, in cases	30	8	240	
Linen Towels, in cases	40	6	240	
Sisal, compressed	21	8	168	
Tow, compressed	29	8	232	
Wool, in bales, compressed	48			
Wool, in bales, not compressed	13	8	104	
Wool, Worsteds, in cases	27	8	216	

WEIGHTS OF VARIOUS MATERIALS

MATERIAL	Specific Gravity Compared With Water at 4 C.	Weight Pounds Per Cu. Ft.
Alcohol, 100%	0.79	49
Acid, muriatic, 40%	1.20	75
Acid, nitric, 91%	1.50	94
Acid, sulphuric, 87%	1.80	112
Cereals, oats, bulk		32
Cereals, barley, bulk		39
Cereals, corn, rye, bulk		48
Cereals, wheat, bulk		48
Cotton, flax, hemp	1.47 — 1.50	93
Flour, pressed	0.70 — 0.80	47
Flour, loose	0.40 — 0.50	28
Glass, common	2.40 — 2.60	156
Glass, plate or crown	2.45 — 2.72	161
Glass, crystal	2.90 — 3.00	184
Hay and straw, bales		20
Iron, cast, pig	7.2	450
Iron, wrought	7.6 — 7.9	485
Iron, steel	7.8 — 7.9	490
Leather	0.86 — 1.02	59
Lye, soda, 66%	1.70	106
Lead	11.37	710
Manganese	7.2 — 8.0	475
Mercury	13.6	849
Nickel	8.9 — 9.2	565
Oils, vegetable	0.91 — 0.94	58
Oils, mineral, lubricant	0.90 — 0.93	57
Paper	0.70 — 1.15	58
Platinum, cast-hammered	21.1 —21.5	1330
Potatoes, piled		42
Rubber, caoutchouc	0.92 — 0.96	59
Rubber goods	1.00 — 2.00	94
Salt, granulated, piled		48
Saltpeter		67
Starch	1.53	96
Sulphur	1.93 — 2.07	125
Silver, cast-hammered	10.4 —10.6	656
Tin, cast-hammered	7.2 — 7.5	459
Water, 4° C. maximum density	1.00	62.428
Water, 100° C.	0.9584	59.830
Water, ice	0.88 — 0.92	56
Water, snow	.125	8
Water, sea	1.02 — 1.03	64
Wool	1.32	82
Zinc, cast-rolled	6.9 — 7.2	440

TRIGONOMETRIC FORMULAS



Radius, $1 = \sin^2 A + \cos^2 A$

$= \sin A \operatorname{cosec} A = \cos A \sec A = \tan A \cot A$

Sine $A = \frac{\cos A}{\cot A} = \frac{1}{\operatorname{cosec} A} = \cos A \tan A = \sqrt{1 - \cos^2 A}$

Cosine $A = \frac{\sin A}{\tan A} = \frac{1}{\sec A} = \sin A \cot A = \sqrt{1 - \sin^2 A}$

Tangent $A = \frac{\sin A}{\cos A} = \frac{1}{\cot A} = \sin A \sec A$

Cotangent $A = \frac{\cos A}{\sin A} = \frac{1}{\tan A} = \cos A \operatorname{cosec} A$

Secant $A = \frac{\tan A}{\sin A} = \frac{1}{\cos A}$

Cosecant $A = \frac{\cot A}{\cos A} = \frac{1}{\sin A}$

$\sin (A \pm B) = \sin A \cos B \pm \cos A \sin B$

$\cos (A \pm B) = \cos A \cos B \mp \sin A \sin B$

$\sin A + \sin B = 2 \sin \frac{1}{2}(A + B) \cos \frac{1}{2}(A - B)$

$\sin A - \sin B = 2 \cos \frac{1}{2}(A + B) \sin \frac{1}{2}(A - B)$

$\cos A + \cos B = 2 \cos \frac{1}{2}(A + B) \cos \frac{1}{2}(A - B)$

$\cos B - \cos A = 2 \sin \frac{1}{2}(A + B) \sin \frac{1}{2}(A - B)$

$\sin 2A = 2 \sin A \cos A$

$\cos 2A = \cos^2 A - \sin^2 A$

$\sin \frac{1}{2} A = \sqrt{\frac{1 - \cos A}{2}}$ $\quad \cos \frac{1}{2} A = \sqrt{\frac{1 + \cos A}{2}}$

$\sin^2 A = \frac{1 - \cos 2A}{2}$ $\quad \cos^2 A = \frac{1 + \cos 2A}{2}$

$\sin^2 A - \sin^2 B = \sin (A + B) \sin (A - B)$

$\frac{\sin A \pm \sin B}{\cos A + \cos B} = \tan \frac{1}{2}(A \pm B)$

$\tan (A \pm B) = \frac{\tan A \pm \tan B}{1 + \tan A \tan B}$

$\cot (A \pm B) = \frac{\cot A \cot B \mp 1}{\cot B \pm \cot A}$

$\tan A + \tan B = \frac{\sin (A + B)}{\cos A \cos B}$

$\tan A - \tan B = \frac{\sin (A - B)}{\cos A \cos B}$

$\cot A + \cot B = \frac{\sin (B + A)}{\sin A \sin B}$

$\cot A - \cot B = \frac{\sin (B - A)}{\sin A \sin B}$

$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$

$\cot 2A = \frac{\cot^2 A - 1}{2 \cot A}$

$\tan \frac{1}{2} A = \frac{\sin A}{1 + \cos A}$ $\quad \cot \frac{1}{2} A = \frac{\sin A}{1 - \cos A}$

$\tan^2 A = \frac{1 - \cos 2A}{1 + \cos 2A}$ $\quad \cot^2 A = \frac{1 + \cos 2A}{1 - \cos 2A}$

$\cos^2 A - \sin^2 B = \cos (A + B) \cos (A - B)$

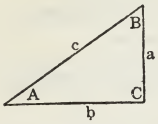
$\frac{\sin A \pm \sin B}{\cos B - \cos A} = \cot \frac{1}{2}(A \mp B)$

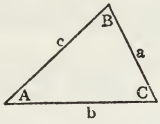
Quadrant	I	II	III	IV	Angle		
Angles	0° to 90°	90° to 180°	180° to 270°	270° to 360°	30°	45°	60°
Functions	Values vary from				Equivalent values		
sin	+0 to +1	+1 to +0	−0 to −1	−1 to −0	$\frac{1}{2}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}\sqrt{3}$
cos	+1 to +0	−0 to −1	−1 to −0	+0 to +1	$\frac{1}{2}\sqrt{3}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}$
tan	+0 to +∞	−∞ to −0	+0 to +∞	−∞ to −0	$\frac{1}{3}\sqrt{3}$	1	$\sqrt{3}$
cot	+∞ to +0	−0 to −∞	+∞ to +0	−0 to −∞	$\sqrt{3}$	1	$\frac{1}{3}\sqrt{3}$

Angle a < 90°				
Angle	sin	cos	tan	cot
$\phi°$	$\phi°$	$\phi°$	$\phi°$	$\phi°$
$0° \pm a$	$\pm \sin a$	$+\cos a$	$\pm \tan a$	$\pm \cot a$
$90° \pm a$	$+\cos a$	$\mp \sin a$	$\mp \cot a$	$\mp \tan a$
$180° \pm a$	$\mp \sin a$	$-\cos a$	$\pm \tan a$	$\pm \cot a$
$270° \pm a$	$-\cos a$	$\pm \sin a$	$\mp \cot a$	$\mp \tan a$

TRIGONOMETRIC SOLUTION OF TRIANGLES

(Carnegie Steel Co., Pocket Companion, 21st Edition)





$S = \frac{a+b+c}{2}$

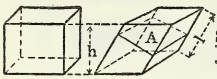
Given	Sought	Formulae
		Right-Angled Triangles
a, c	A, B, b	$\sin A = \frac{a}{c}$, $\cos B = \frac{a}{c}$, $b = \sqrt{c^2 - a^2}$
	Area	Area $= \frac{a}{2}\sqrt{c^2-a^2}$
a, b	A, B, c	$\tan A = \frac{a}{b}$, $\tan B = \frac{b}{a}$, $c = \sqrt{a^2 + b^2}$
	Area	Area $= \frac{a\,b}{2}$
A, a	B, b, c	$B = 90° - A$, $b = a \cot A$, $c = \frac{a}{\sin A}$
	Area	Area $= \frac{a^2 \cot A}{2}$
A, b	B, a, c	$B = 90° - A$, $a = b \tan A$, $c = \frac{b}{\cos A}$
	Area	Area $= \frac{b^2 \tan A}{2}$
A, c	B, a, b	$B = 90° - A$, $a = c \sin A$, $b = c \cos A$
	Area	Area $= \frac{c^2 \sin A \cos A}{2}$ or $\frac{c^2 \sin 2A}{4}$
		Oblique-Angled Triangles
a, b, c	A	$\sin \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{b\,c}}$, $\cos \frac{1}{2} A = \sqrt{\frac{s(s-a)}{b\,c}}$, $\tan \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$
	B	$\sin \frac{1}{2} B = \sqrt{\frac{(s-a)(s-c)}{a\,c}}$, $\cos \frac{1}{2} B = \sqrt{\frac{s(s-b)}{a\,c}}$, $\tan \frac{1}{2} B = \sqrt{\frac{(s-a)(s-c)}{s(s-b)}}$
	C	$\sin \frac{1}{2} C = \sqrt{\frac{(s-a)(s-b)}{a\,b}}$, $\cos \frac{1}{2} C = \sqrt{\frac{s(s-c)}{a\,b}}$, $\tan \frac{1}{2} C = \sqrt{\frac{(s-a)(s-b)}{s(s-c)}}$
	Area	Area $= \sqrt{s(s-a)(s-b)(s-c)}$
a, A, B	b, c	$b = \frac{a \sin B}{\sin A}$, $c = \frac{a \sin C}{\sin A} = \frac{a \sin (A+B)}{\sin A}$
	Area	Area $= \frac{1}{2} a\,b \sin C = \frac{a^2 \sin B \sin C}{2 \sin A}$
a, b, A	B	$\sin B = \frac{b \sin A}{a}$
	c	$c = \frac{a \sin C}{\sin A} = \frac{b \sin C}{\sin B} = \sqrt{a^2 + b^2 - 2\,ab \cos C}$
	Area	Area $= \frac{1}{2} a\,b \sin C$
a, b, C	A	$\tan A = \frac{a \sin C}{b - a \cos C}$, $\tan \frac{1}{2}(A-B) = \frac{a-b}{a+b} \cot \frac{1}{2} C$
	c	$c = \sqrt{a^2 + b^2 - 2\,ab \cos C} = \frac{a \sin C}{\sin A}$
	Area	Area $= \frac{1}{2} ab \sin C$

$a^2 = b^2 + c^2 - 2bc \cos A$, $b^2 = a^2 + c^2 - 2\,a\,c \cos B$, $c^2 = a^2 + b^2 - 2\,ab \cos C$

SURFACE AND VOLUME OF SOLIDS

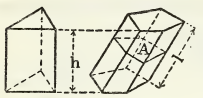
(Carnegie Steel Co., Pocket Companion, 21st Edition)

S=Lateral or Convex Surface. V=Volume



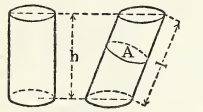
Parallelopiped

S=perimeter, P, perp. to sides x lat. length, l: Pl
V=area of base, B x perpendicular height, h: Bh
V=area of section, A, perp. to sides x lat. length, l: Al



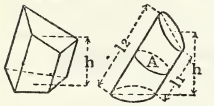
Prism, Right or Oblique, Regular or Irregular

S=perimeter, P, perp. to sides x lat. length, l: Pl
V=area of base, B x perpendicular height, h: Bh
V=area of section, A, perp. to sides x lat. length, l: Al



Cylinder, Right or Oblique, Circular or Elliptic, etc.

S=perimeter of base, C x perp. height, h: Ch
S=perimeter, P, perp. to sides x lat. length, l: Pl
V=area of base, B x perpendicular height, h: Bh
V=area of section, A, perp. to sides x lat. length, l: Al

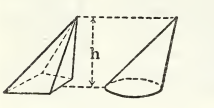


Frustum of any Prism or Cylinder

V=area of base, B x perp. distance, h, from base to center of gravity of opposite face: Bh
For cylinder: $\frac{1}{2} A (l_1 + l_2)$

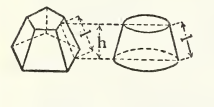
Pyramid or Cone, Right and Regular

S=perimeter of base, B x ½ slant height, l: ½ Bl
V=area of base, B x ⅓ perp. height, h: ⅓ Bh



Pyramid or Cone, Right or Oblique, Regular or Irregular

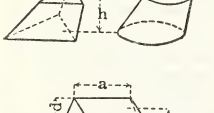
V=area of base, B x ⅓ perp. height, h: ⅓ Bh
V=⅓ volume of prism or cylinder of same base and perpendicular height
V=½ volume of hemisphere of same base and perpendicular height



Frustum of Pyramid or Cone, Right and Regular, Parallel Ends

S=(sum of perimeter of base, B, and top, b) x ½ slant height, l: $\frac{1}{2} l (B + b)$
V=(sum of areas of base, B, and top, b + square root of their products) x ⅓ perp. height, h:

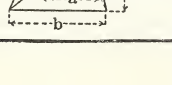
$$\frac{1}{3} h \left(B + b + \sqrt{B b}\right)$$



Frustum of any Pyramid or Cone, Parallel Ends

V=(sum of areas of base, B, and top, b + square root of their products) x ⅓ perp. height, h:

$$\frac{1}{3} h \left(B + b + \sqrt{B b}\right)$$



Wedge, Parallelogram Face

V=⅙ (sum of three edges, a b a x perpendicular height, h x perpendicular width, d):

$$\frac{1}{6} d h (2a + b)$$

SURFACE AND VOLUME OF SOLIDS—Concluded

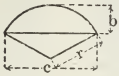
(Carnegie Steel Co., Pocket Companion, 21st Edition)

S=Lateral or Convex Surface. V=Volume

Sphere

$S = 4\ \pi\ r^2 = \quad \pi\ d^2 = 3.14159265\ d^2$

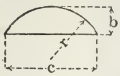
$V = \frac{4}{3}\ \pi\ r^3 = \frac{1}{6}\ \pi\ d^3 = 0.52359878\ d^3.$



Spherical Sector

$S = \frac{1}{2}\ \pi\ r\ (4\ b + c)$

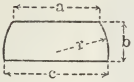
$V = \frac{2}{3}\ \pi\ r^2\ b$



Spherical Segment

$S = 2\ \pi\ r\ b = \frac{1}{4}\ \pi\ (4\ b^2 + c^2)$

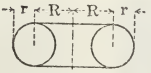
$V = \frac{1}{3}\ \pi\ b^2\ (3\ r - b) = \frac{1}{24}\ \pi\ b\ (3\ c^2 + 4\ b^2)$



Spherical Zone

$S = 2\ \pi\ r\ b$

$V = \frac{1}{24}\ \pi\ b\ (3\ a^2 + 3\ c^2 + 4\ b^2)$

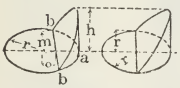


Circular Ring

$S = 4\ \pi^2\ R\ r$

$V = 2\ \pi^2\ R\ r^2$

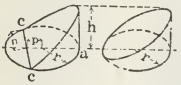
Ungula of Right, Regular Cylinder



Base=Segment, b a b — Base=Half Circle

$S = (2\ r\ m\text{–}o \times \text{arc, b a b})\ \frac{h}{r - o}$ — $S = 2\ r\ h$

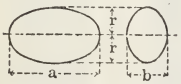
$V = (\frac{2}{3}\ m^3\text{–}o \times \text{area, b a b})\ \frac{h}{r - o}$ — $V = \frac{2}{3}\ r^2\ h$



Base=Segment, c a c — Base=Circle

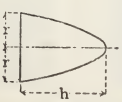
$S = (2\ r\ n + p \times \text{arc, c a c})\ \frac{h}{r + p}$ — $S = r\ \pi\ h$

$V = (\frac{2}{3}\ n^3 + p \times \text{area, c a c})\ \frac{h}{r + p}$ — $V = \frac{1}{2}\ r^2\ \pi\ h$



Ellipsoid

$V = \frac{1}{3}\ \pi\ r\ a\ b$



Paraboloid

$V = \frac{1}{2}\ \pi\ r^2\ h$

Ratio of corresponding volumes of a Cone, Paraboloid, Sphere, and Cylinder of equal height: ⅓: ½: ⅔: 1

FUNCTIONS OF NUMBERS, 1 to 49

(Carnegie Steel Co., Pocket Companion, 21st Edition)

No.	Square	Cube	Square Root	Cubic Root	Logarithm
1	1	1	1.0000	1.0000	0.00000
2	4	8	1.4142	1.2599	0.30103
3	9	27	1.7321	1.4422	0.47712
4	16	64	2.0000	1.5874	0.60206
5	25	125	2.2361	1.7100	0.69897
6	36	216	2.4495	1.8171	0.77815
7	49	343	2.6458	1.9129	0.84510
8	64	512	2.8284	2.0000	0.90309
9	81	729	3.0000	2.0801	0.95424
10	100	1000	3.1623	2.1544	1.00000
11	121	1331	3.3166	2.2240	1.04139
12	144	1728	3.4641	2.2894	1.07918
13	169	2197	3.6056	2.3513	1.11394
14	196	2744	3.7417	2.4101	1.14613
15	225	3375	3.8730	2.4662	1.17609
16	256	4096	4.0000	2.5198	1.20412
17	289	4913	4.1231	2.5713	1.23045
18	324	5832	4.2426	2.6207	1.25527
19	361	6859	4.3589	2.6684	1.27875
20	400	8000	4.4721	2.7144	1.30103
21	441	9261	4.5826	2.7589	1.32222
22	484	10648	4.6904	2.8020	1.34242
23	529	12167	4.7958	2.8439	1.36173
24	576	13824	4.8990	2.8845	1.38021
25	625	15625	5.0000	2.9240	1.39794
26	676	17576	5.0990	2.9625	1.41497
27	729	19683	5.1962	3.0000	1.43136
28	784	21952	5.2915	3.0366	1.44716
29	841	24389	5.3852	3.0723	1.46240
30	900	27000	5.4772	3.1072	1.47712
31	961	29791	5.5678	3.1414	1.49136
32	1024	32768	5.6569	3.1748	1.50515
33	1089	35937	5.7446	3.2075	1.51851
34	1156	39304	5.8310	3.2396	1.53148
35	1225	42875	5.9161	3.2711	1.54407
36	1296	46656	6.0000	3.3019	1.55630
37	1369	50653	6.0828	3.3322	1.56820
38	1444	54872	6.1644	3.3620	1.57978
39	1521	59319	6.2450	3.3912	1.59106
40	1600	64000	6.3246	3.4200	1.60206
41	1681	68921	6.4031	3.4482	1.61278
42	1764	74088	6.4807	3.4760	1.62325
43	1849	79507	6.5574	3.5034	1.63347
44	1936	85184	6.6332	3.5303	1.64345
45	2025	91125	6.7082	3.5569	1.65321
46	2116	97336	6.7823	3.5830	1.66276
47	2209	103823	6.8557	3.6088	1.67210
48	2304	110592	6.9282	3.6342	1.68124
49	2401	117649	7.0000	3.6593	1.69020

FUNCTIONS OF NUMBERS, 50 to 99

(Carnegie Steel Co., Pocket Companion, 21st Edition)

No.	Square	Cube	Square Root	Cubic Root	Logarithm
50	2500	125000	7.0711	3.6840	1.69897
51	2601	132651	7.1414	3.7084	1.70757
52	2704	140608	7.2111	3.7325	1.71600
53	2809	148877	7.2801	3.7563	1.72428
54	2916	157464	7.3485	3.7798	1.73239
55	3025	166375	7.4162	3.8030	1.74036
56	3136	175616	7.4833	3.8259	1.74819
57	3249	185193	7.5498	3.8485	1.75587
58	3364	195112	7.6158	3.8709	1.76343
59	3481	205379	7.6811	3.8930	1.77085
60	3600	216000	7.7460	3.9149	1.77815
61	3721	226981	7.8102	3.9365	1.78533
62	3844	238328	7.8740	3.9579	1.79239
63	3969	250047	7.9373	3.9791	1.79934
64	4096	262144	8.0000	4.0000	1.80618
65	4225	274625	8.0623	4.0207	1.81291
66	4356	287496	8.1240	4.0412	1.81954
67	4489	300763	8.1854	4.0615	1.82607
68	4624	314432	8.2462	4.0817	1.83251
69	4761	328509	8.3066	4.1016	1.83885
70	4900	343000	8.3666	4.1213	1.84510
71	5041	357911	8.4261	4.1408	1.85126
72	5184	373248	8.4853	4.1602	1.85733
73	5329	389017	8.5440	4.1793	1.86332
74	5476	405224	8.6023	4.1983	1.86923
75	5625	421875	8.6603	4.2172	1.87506
76	5776	438976	8.7178	4.2358	1.88081
77	5929	456533	8.7750	4.2543	1.88649
78	6084	474552	8.8318	4.2727	1.89209
79	6241	493039	8.8882	4.2908	1.89763
80	6400	512000	8.9443	4.3089	1.90309
81	6561	531441	9.0000	4.3267	1.90849
82	6724	551368	9.0554	4.3445	1.91381
83	6889	571787	9.1104	4.3621	1.91908
84	7056	592704	9.1652	4.3795	1.92428
85	7225	614125	9.2195	4.3968	1.92942
86	7396	636056	9.2736	4.4140	1.93450
87	7569	658503	9.3274	4.4310	1.93952
88	7744	681472	9.3808	4.4480	1.94448
89	7921	704969	9.4340	4.4647	1.94939
90	8100	729000	9.4868	4.4814	1.95424
91	8281	753571	9.5394	4.4979	1.95904
92	8464	778688	9.5917	4.5144	1.96379
93	8649	804357	9.6437	4.5307	1.96848
94	8836	830584	9.6954	4.5468	1.97313
95	9025	857375	9.7468	4.5629	1.97772
96	9216	884736	9.7980	4.5789	1.98227
97	9409	912673	9.8489	4.5947	1.98677
98	9604	941192	9.8995	4.6104	1.99123
99	9801	970299	9.9499	4.6261	1.99564

FUNCTIONS OF NUMBERS, 100 to 149

(Carnegie Steel Co., Pocket Companion, 21st Edition)

No.	Square	Cube	Square Root	Cubic Root	Logarithm
100	10000	1000000	10.0000	4.6416	2.00000
101	10201	1030301	10.0499	4.6570	2.00432
102	10404	1061208	10.0995	4.6723	2.00860
103	10609	1092727	10.1489	4.6875	2.01284
104	10816	1124864	10.1980	4.7027	2.01703
105	11025	1157625	10.2470	4.7177	2.02119
106	11236	1191016	10.2956	4.7326	2.02531
107	11449	1225043	10.3441	4.7475	2.02938
108	11664	1259712	10.3923	4.7622	2.03342
109	11881	1295029	10.4403	4.7769	2.03743
110	12100	1331000	10.4881	4.7914	2.04139
111	12321	1367631	10.5357	4.8059	2.04532
112	12544	1404928	10.5830	4.8203	2.04922
113	12769	1442897	10.6301	4.8346	2.05308
114	12996	1481544	10.6771	4.8488	2.05690
115	13225	1520875	10.7238	4.8629	2.06070
116	13456	1560896	10.7703	4.8770	2.06446
117	13689	1601613	10.8167	4.8910	2.06819
118	13924	1643032	10.8628	4.9049	2.07188
119	14161	1685159	10.9087	4.9187	2.07555
120	14400	1728000	10.9545	4.9324	2.07918
121	14641	1771561	11.0000	4.9461	2.08279
122	14884	1815848	11.0454	4.9597	2.08636
123	15129	1860867	11.0905	4.9732	2.08991
124	15376	1906624	11.1355	4.9866	2.09342
125	15625	1953125	11.1803	5.0000	2.09691
126	15876	2000376	11.2250	5.0133	2.10037
127	16129	2048383	11.2694	5.0265	2.10380
128	16384	2097152	11.3137	5.0397	2.10721
129	16641	2146689	11.3578	5.0528	2.11059
130	16900	2197000	11.4018	5.0658	2.11394
131	17161	2248091	11.4455	5.0788	2.11727
132	17424	2299968	11.4891	5.0916	2.12057
133	17689	2352637	11.5326	5.1045	2.12385
134	17956	2406104	11.5758	5.1172	2.12710
135	18225	2460375	11.6190	5.1299	2.13033
136	18496	2515456	11.6619	5.1426	2.13354
137	18769	2571353	11.7047	5.1551	2.13672
138	19044	2628072	11.7473	5.1676	2.13988
139	19321	2685619	11.7898	5.1801	2.14301
140	19600	2744000	11.8322	5.1925	2.14613
141	19881	2803221	11.8743	5.2048	2.14922
142	20164	2863288	11.9164	5.2171	2.15229
143	20449	2924207	11.9583	5.2293	2.15534
144	20736	2985984	12.0000	5.2415	2.15836
145	21025	3048625	12.0416	5.2536	2.16137
146	21316	3112136	12.0830	5.2656	2.16435
147	21609	3176523	12.1244	5.2776	2.16732
148	21904	3241792	12.1655	5.2896	2.17026
149	22201	3307949	12.2066	5.3015	2.17319

FUNCTIONS OF NUMBERS, 150 to 199

(Carnegie Steel Co., Pocket Companion, 21st Edition)

No.	Square	Cube	Square Root	Cubic Root	Logarithm
150	22500	3375000	12.2474	5.3133	2.17609
151	22801	3442951	12.2882	5.3251	2.17898
152	23104	3511808	12.3288	5.3368	2.18184
153	23409	3581577	12.3693	5.3485	2.18469
154	23716	3652264	12.4097	5.3601	2.18752
155	24025	3723875	12.4499	5.3717	2.19033
156	24336	3796416	12.4900	5.3832	2.19312
157	24649	3869893	12.5300	5.3947	2.19590
158	24964	3944312	12.5698	5.4061	2.19866
159	25281	4019679	12.6095	5.4175	2.20140
160	25600	4096000	12.6491	5.4288	2.20412
161	25921	4173281	12.6886	5.4401	2.20683
162	26244	4251528	12.7279	5.4514	2.20952
163	26569	4330747	12.7671	5.4626	2.21219
164	26896	4410944	12.8062	5.4737	2.21484
165	27225	4492125	12.8452	5.4848	2.21748
166	27556	4574296	12.8841	5.4959	2.22011
167	27889	4657463	12.9228	5.5069	2.22272
168	28224	4741632	12.9615	5.5178	2.22531
169	28561	4826809	13.0000	5.5288	2.22789
170	28900	4913000	13.0384	5.5397	2.23045
171	29241	5000211	13.0767	5.5505	2.23300
172	29584	5088448	13.1149	5.5613	2.23553
173	29929	5177717	13.1529	5.5721	2.23805
174	30276	5268024	13.1909	5.5828	2.24055
175	30625	5359375	13.2288	5.5934	2.24304
176	30976	5451776	13.2665	5.6041	2.24551
177	31329	5545233	13.3041	5.6147	2.24797
178	31684	5639752	13.3417	5.6252	2.25042
179	32041	5735339	13.3791	5.6357	2.25285
180	32400	5832000	13.4164	5.6462	2.25527
181	32761	5929741	13.4536	5.6567	2.25768
182	33124	6028568	13.4907	5.6671	2.26007
183	33489	6128487	13.5277	5.6774	2.26245
184	33856	6229504	13.5647	5.6877	2.26482
185	34225	6331625	13.6015	5.6980	2.26717
186	34596	6434856	13.6382	5.7083	2.26951
187	34969	6539203	13.6748	5.7185	2.27184
188	35344	6644672	13.7113	5.7287	2.27416
189	35721	6751269	13.7477	5.7388	2.27646
190	36100	6859000	13.7840	5.7489	2.27875
191	36481	6967871	13.8203	5.7590	2.28103
192	36864	7077888	13.8564	5.7690	2.28330
193	37249	7189057	13.8924	5.7790	2.28556
194	37636	7301384	13.9284	5.7890	2.28780
195	38025	7414875	13.9642	5.7989	2.29003
196	38416	7529536	14.0000	5.8088	2.29226
197	38809	7645373	14.0357	5.8186	2.29447
198	39204	7762392	14.0712	5.8285	2.29667
199	39601	7880599	14.1067	5.8383	2.29885

FUNCTIONS OF NUMBERS, 200 to 249

(Carnegie Steel Co., Pocket Companion, 21st Edition)

No.	Square	Cube	Square Root	Cubic Root	Logarithm
200	40000	8000000	14.1421	5.8480	2.30103
201	40401	8120601	14.1774	5.8578	2.30320
202	40804	8242408	14.2127	5.8675	2.30535
203	41209	8365427	14.2478	5.8771	2.30750
204	41616	8489664	14.2829	5.8868	2.30963
205	42025	8615125	14.3178	5.8964	2.31175
206	42436	8741816	14.3527	5.9059	2.31387
207	42849	8869743	14.3875	5.9155	2.31597
208	43264	8998912	14.4222	5.9250	2.31806
209	43681	9129329	14.4568	5.9345	2.32015
210	44100	9261000	14.4914	5.9439	2.32222
211	44521	9393931	14.5258	5.9533	2.32428
212	44944	9528128	14.5602	5.9627	2.32634
213	45369	9663597	14.5945	5.9721	2.32838
214	45796	9800344	14.6287	5.9814	2.33041
215	46225	9938375	14.6629	5.9907	2.33244
216	46656	10077696	14.6969	6.0000	2.33445
217	47089	10218313	14.7309	6.0092	2.33646
218	47524	10360232	14.7648	6.0185	2.33846
219	47961	10503459	14.7986	6.0277	2.34044
220	48400	10648000	14.8324	6.0368	2.34242
221	48841	10793861	14.8661	6.0459	2.34439
222	49284	10941048	14.8997	6.0550	2.34635
223	49729	11089567	14.9332	6.0641	2.34830
224	50176	11239424	14.9666	6.0732	2.35025
225	50625	11390625	15.0000	6.0822	2.35218
226	51076	11543176	15.0333	6.0912	2.35411
227	51529	11697083	15.0665	6.1002	2.35603
228	51984	11852352	15.0997	6.1091	2.35793
229	52441	12008989	15.1327	6.1180	2.35984
230	52900	12167000	15.1658	6.1269	2.36173
231	53361	12326391	15.1987	6.1358	2.36361
232	53824	12487168	15.2315	6.1446	2.36549
233	54289	12649337	15.2643	6.1534	2.36736
234	54756	12812904	15.2971	6.1622	2.36922
235	55225	12977875	15.3297	6.1710	2.37107
236	55696	13144256	15.3623	6.1797	2.37291
237	56169	13312053	15.3948	6.1885	2.37475
238	56644	13481272	15.4272	6.1972	2.37658
239	57121	13651919	15.4596	6.2058	2.37840
240	57600	13824000	15.4919	6.2145	2.38021
241	58081	13997521	15.5242	6.2231	2.38202
242	58564	14172488	15.5563	6.2317	2.38382
243	59049	14348907	15.5885	6.2403	2.38561
244	59536	14526784	15.6205	6.2488	2.38739
245	60025	14706125	15.6525	6.2573	2.38917
246	60516	14886936	15.6844	6.2658	2.39094
247	61009	15069223	15.7162	6.2743	2.39270
248	61504	15252992	15.7480	6.2828	2.39445
249	62001	15438249	15.7797	6.2912	2.39620

FUNCTIONS OF NUMBERS, 250 to 299

(Carnegie Steel Co., Pocket Companion, 21st Edition)

No.	Square	Cube	Square Root	Cubic Root	Logarithm
250	62500	15625000	15.8114	6.2996	2.39794
251	63001	15813251	15.8430	6.3080	2.39967
252	63504	16003008	15.8745	6.3164	2.40140
253	64009	16194277	15.9060	6.3247	2.40312
254	64516	16387064	15.9374	6.3330	2.40483
255	65025	16581375	15.9687	6.3413	2.40654
256	65536	16777216	16.0000	6.3496	2.40824
257	66049	16974593	16.0312	6.3579	2.40993
258	66564	17173512	16.0624	6.3661	2.41162
259	67081	17373979	16.0935	6.3743	2.41330
260	67600	17576000	16.1245	6.3825	2.41497
261	68121	17779581	16.1555	6.3907	2.41664
262	68644	17984728	16.1864	6.3988	2.41830
263	69169	18191447	16.2173	6.4070	2.41996
264	69696	18399744	16.2481	6.4151	2.42160
265	70225	18609625	16.2788	6.4232	2.42325
266	70756	18821096	16.3095	6.4312	2.42488
267	71289	19034163	16.3401	6.4393	2.42651
268	71824	19248832	16.3707	6.4473	2.42813
269	72361	19465109	16.4012	6.4553	2.42975
270	72900	19683000	16.4317	6.4633	2.43136
271	73441	19902511	16.4621	6.4713	2.43297
272	73984	20123648	16.4924	6.4792	2.43457
273	74529	20346417	16.5227	6.4872	2.43616
274	75076	20570824	16.5529	6.4951	2.43775
275	75625	20796875	16.5831	6.5030	2.43933
276	76176	21024576	16.6132	6.5108	2.44091
277	76729	21253933	16.6433	6.5187	2.44248
278	77284	21484952	16.6733	6.5265	2.44404
279	77841	21717639	16.7033	6.5343	2.44560
280	78400	21952000	16.7332	6.5421	2.44716
281	78961	22188041	16.7631	6.5499	2.44871
282	79524	22425768	16.7929	6.5577	2.45025
283	80089	22665187	16.8226	6.5654	2.45179
284	80656	22906304	16.8523	6.5731	2.45332
285	81225	23149125	16.8819	6.5808	2.45484
286	81796	23393656	16.9115	6.5885	2.45637
287	82369	23639903	16.9411	6.5962	2.45788
288	82944	23887872	16.9706	6.6039	2.45939
289	83521	24137569	17.0000	6.6115	2.46090
290	84100	24389000	17.0294	6.6191	2.46240
291	84681	24642171	17.0587	6.6267	2.46389
292	85264	24897088	17.0880	6.6343	2.46538
293	85849	25153757	17.1172	6.6419	2.46687
294	86436	25412184	17.1464	6.6494	2.46835
295	87025	25672375	17.1756	6.6569	2.46982
296	87616	25934336	17.2047	6.6644	2.47129
297	88209	26198073	17.2337	6.6719	2.47276
298	88804	26463592	17.2627	6.6794	2.47422
299	89401	26730899	17.2916	6.6869	2.47567

FUNCTIONS OF NUMBERS, 300 to 349

(Carnegie Steel Co., Pocket Companion, 21st Edition)

No.	Square	Cube	Square Root	Cubic Root	Logarithm
300	90000	27000000	17.3205	6.6943	2.47712
301	90601	27270901	17.3494	6.7018	2.47857
302	91204	27543608	17.3781	6.7092	2.48001
303	91809	27818127	17.4069	6.7166	2.48144
304	92416	28094464	17.4356	6.7240	2.48287
305	93025	28372625	17.4642	6.7313	2.48430
306	93636	28652616	17.4929	6.7387	2.48572
307	94249	28934443	17.5214	6.7460	2.48714
308	94864	29218112	17.5499	6.7533	2.48855
309	95481	29503629	17.5784	6.7606	2.48996
310	96100	29791000	17.6068	6.7679	2.49136
311	96721	30080231	17.6352	6.7752	2.49276
312	97344	30371328	17.6635	6.7824	2.49415
313	97969	30664297	17.6918	6.7897	2.49554
314	98596	30959144	17.7200	6.7969	2.49693
315	99225	31255875	17.7482	6.8041	2.49831
316	99856	31554496	17.7764	6.8113	2.49969
317	100489	31855013	17.8045	6.8185	2.50106
318	101124	32157432	17.8326	6.8256	2.50243
319	101761	32461759	17.8606	6.8328	2.50379
320	102400	32768000	17.8885	6.8399	2.50515
321	103041	33076161	17.9165	6.8470	2.50651
322	103684	33386248	17.9444	6.8541	2.50786
323	104329	33698267	17.9722	6.8612	2.50920
324	104976	34012224	18.0000	6.8683	2.51055
325	105625	34328125	18.0278	6.8753	2.51188
326	106276	34645976	18.0555	6.8824	2.51322
327	106929	34965783	18.0831	6.8894	2.51455
328	107584	35287552	18.1108	6.8964	2.51587
329	108241	35611289	18.1384	6.9034	2.51720
330	108900	35937000	18.1659	6.9104	2.51851
331	109561	36264691	18.1934	6.9174	2.51983
332	110224	36594368	18.2209	6.9244	2.52114
333	110889	36926037	18.2483	6.9313	2.52244
334	111556	37259704	18.2757	6.9382	2.52375
335	112225	37595375	18.3030	6.9451	2.52504
336	112896	37933056	18.3303	6.9521	2.52634
337	113569	38272753	18.3576	6.9589	2.52763
338	114244	38614472	18.3848	6.9658	2.52892
339	114921	38958219	18.4120	6.9727	2.53020
340	115600	39304000	18.4391	6.9795	2.53148
341	116281	39651821	18.4662	6.9864	2.53275
342	116964	40001688	18.4932	6.9932	2.53403
343	117649	40353607	18.5203	7.0000	2.53529
344	118336	40707584	18.5472	7.0068	2.53656
345	119025	41063625	18.5742	7.0136	2.53782
346	119716	41421736	18.6011	7.0203	2.53908
347	120409	41781923	18.6279	7.0271	2.54033
348	121104	42144192	18.6548	7.0338	2.54158
349	121801	42508549	18.6815	7.0406	2.54283

FUNCTIONS OF NUMBERS, 350 to 399

(Carnegie Steel Co., Pocket Companion, 21st Edition)

No.	Square	Cube	Square Root	Cubic Root	Logarithm
350	122500	42875000	18.7083	7.0473	2.54407
351	123201	43243551	18.7350	7.0540	2.54531
352	123904	43614208	18.7617	7.0607	2.54654
353	124609	43986977	18.7883	7.0674	2.54777
354	125316	44361864	18.8149	7.0740	2.54900
355	126025	44738875	18.8414	7.0807	2.55023
356	126736	45118016	18.8680	7.0873	2.55145
357	127449	45499293	18.8944	7.0940	2.55267
358	128164	45882712	18.9209	7.1006	2.55388
359	128881	46268279	18.9473	7.1072	2.55509
360	129600	46656000	18.9737	7.1138	2.55630
361	130321	47045881	19.0000	7.1204	2.55751
362	131044	47437928	19.0263	7.1269	2.55871
363	131769	47832147	19.0526	7.1335	2.55991
364	132496	48228544	19.0788	7.1400	2.56110
365	133225	48627125	19.1050	7.1466	2.56229
366	133956	49027896	19.1311	7.1531	2.56348
367	134689	49430863	19.1572	7.1596	2.56467
368	135424	49836032	19.1833	7.1661	2.56585
369	136161	50243409	19.2094	7.1726	2.56703
370	136900	50653000	19.2354	7.1791	2.56820
371	137641	51064811	19.2614	7.1855	2.56937
372	138384	51478848	19.2873	7.1920	2.57054
373	139129	51895117	19.3132	7.1984	2.57171
374	139876	52313624	19.3391	7.2048	2.57287
375	140625	52734375	19.3649	7.2112	2.57403
376	141376	53157376	19.3907	7.2177	2.57519
377	142129	53582633	19.4165	7.2240	2.57634
378	142884	54010152	19.4422	7.2304	2.57749
379	143641	54439939	19.4679	7.2368	2.57864
380	144400	54872000	19.4936	7.2432	2.57978
381	145161	55306341	19.5192	7.2495	2.58093
382	145924	55742968	19.5448	7.2558	2.58206
383	146689	56181887	19.5704	7.2622	2.58320
384	147456	56623104	19.5959	7.2685	2.58433
385	148225	57066625	19.6214	7.2748	2.58546
386	148996	57512456	19.6469	7.2811	2.58659
387	149769	57960603	19.6723	7.2874	2.58771
388	150544	58411072	19.6977	7.2936	2.58883
389	151321	58863869	19.7231	7.2999	2.58995
390	152100	59319000	19.7484	7.3061	2.59106
391	152881	59776471	19.7737	7.3124	2.59218
392	153664	60236288	19.7990	7.3186	2.59329
393	154449	60698457	19.8242	7.3248	2.59439
394	155236	61162984	19.8494	7.3310	2.59550
395	156025	61629875	19.8746	7.3372	2.59660
396	156816	62099136	19.8997	7.3434	2.59770
397	157609	62570773	19.9249	7.3496	2.59879
398	158404	63044792	19.9499	7.3558	2.59988
399	159201	63521199	19.9750	7.3619	2.60097

FUNCTIONS OF NUMBERS, 400 to 449

(Carnegie Steel Co., Pocket Companion, 21st Edition)

No.	Square	Cube	Square Root	Cubic Root	Logarithm
400	160000	64000000	20.0000	7.3681	2.60206
401	160801	64481201	20.0250	7.3742	2.60314
402	161604	64964808	20.0499	7.3803	2.60423
403	162409	65450827	20.0749	7.3864	2.60531
404	163216	65939264	20.0998	7.3925	2.60638
405	164025	66430125	20.1246	7.3986	2.60746
406	164836	66923416	20.1494	7.4047	2.60853
407	165649	67419143	20.1742	7.4108	2.60959
408	166464	67917312	20.1990	7.4169	2.61066
409	167281	68417929	20.2237	7.4229	2.61172
410	168100	68921000	20.2485	7.4290	2.61278
411	168921	69426531	20.2731	7.4350	2.61384
412	169744	69934528	20.2978	7.4410	2.61490
413	170569	70444997	20.3224	7.4470	2.61595
414	171396	70957944	20.3470	7.4530	2.61700
415	172225	71473375	20.3715	7.4590	2.61805
416	173056	71991296	20.3961	7.4650	2.61909
417	173889	72511713	20.4206	7.4710	2.62014
418	174724	73034632	20.4450	7.4770	2.62118
419	175561	73560059	20.4695	7.4829	2.62221
420	176400	74088000	20.4939	7.4889	2.62325
421	177241	74618461	20.5183	7.4948	2.62428
422	178084	75151448	20.5426	7.5007	2.62531
423	178929	75686967	20.5670	7.5067	2.62634
424	179776	76225024	20.5913	7.5126	2.62737
425	180625	76765625	20.6155	7.5185	2.62839
426	181476	77308776	20.6398	7.5244	2.62941
427	182329	77854483	20.6640	7.5302	2.63043
428	183184	78402752	20.6882	7.5361	2.63144
429	184041	78953589	20.7123	7.5420	2.63246
430	184900	79507000	20.7364	7.5478	2.63347
431	185761	80062991	20.7605	7.5537	2.63448
432	186624	80621568	20.7846	7.5595	2.63548
433	187489	81182737	20.8087	7.5654	2.63649
434	188356	81746504	20.8327	7.5712	2.63749
435	189225	82312875	20.8567	7.5770	2.63849
436	190096	82881856	20.8806	7.5828	2.63949
437	190969	83453453	20.9045	7.5886	2.64048
438	191844	84027672	20.9284	7.5944	2.64147
439	192721	84604519	20.9523	7.6001	2.64246
440	193600	85184000	20.9762	7.6059	2.64345
441	194481	85766121	21.0000	7.6117	2.64444
442	195364	86350888	21.0238	7.6174	2.64542
443	196249	86938307	21.0476	7.6232	2.64640
444	197136	87528384	21.0713	7.6289	2.64738
445	198025	88121125	21.0950	7.6346	2.64836
446	198916	88716536	21.1187	7.6403	2.64933
447	199809	89314623	21.1424	7.6460	2.65031
448	200704	89915392	21.1660	7.6517	2.65128
449	201601	90518849	21.1896	7.6574	2.65225

FUNCTIONS OF NUMBERS, 450 to 500

(Carnegie Steel Co., Pocket Companion, 21st Edition)

No.	Square	Cube	Square Root	Cubic Root	Logarithm
450	202500	91125000	21.2132	7.6631	2.65321
451	203401	91733851	21.2368	7.6688	2.65418
452	204304	92345408	21.2603	7.6744	2.65514
453	205209	92959677	21.2838	7.6801	2.65610
454	206116	93576664	21.3073	7.6857	2.65706
455	207025	94196375	21.3307	7.6914	2.65801
456	207936	94818816	21.3542	7.6970	2.65896
457	208849	95443993	21.3776	7.7026	2.65992
458	209764	96071912	21.4009	7.7082	2.66087
459	210681	96702579	21.4243	7.7138	2.66181
460	211600	97336000	21.4476	7.7194	2.66276
461	212521	97972181	21.4709	7.7250	2.66370
462	213444	98611128	21.4942	7.7306	2.66464
463	214369	99252847	21.5174	7.7362	2.66558
464	215296	99897344	21.5407	7.7418	2.66652
465	216225	100544625	21.5639	7.7473	2.66745
466	217156	101194696	21.5870	7.7529	2.66839
467	218089	101847563	21.6102	7.7584	2.66932
468	219024	102503232	21.6333	7.7639	2.67025
469	219961	103161709	21.6564	7.7695	2.67117
470	220900	103823000	21.6795	7.7750	2.67210
471	221841	104487111	21.7025	7.7805	2.67302
472	222784	105154048	21.7256	7.7860	2.67394
473	223729	105823817	21.7486	7.7915	2.67486
474	224676	106496424	21.7715	7.7970	2.67578
475	225625	107171875	21.7945	7.8025	2.67669
476	226576	107850176	21.8174	7.8079	2.67761
477	227529	108531333	21.8403	7.8134	2.67852
478	228484	109215352	21.8632	7.8188	2.67943
479	229441	109902239	21.8861	7.8243	2.68034
480	230400	110592000	21.9089	7.8297	2.68124
481	231361	111284641	21.9317	7.8352	2.68215
482	232324	111980168	21.9545	7.8406	2.68305
483	233289	112678587	21.9773	7.8460	2.68395
484	234256	113379904	22.0000	7.8514	2.68485
485	235225	114084125	22.0227	7.8568	2.68574
486	236196	114791256	22.0454	7.8622	2.68664
487	237169	115501303	22.0681	7.8676	2.68753
488	238144	116214272	22.0907	7.8730	2.68842
489	239121	116930169	22.1133	7.8784	2.68931
490	240100	117649000	22.1359	7.8837	2.69020
491	241081	118370771	22.1585	7.8891	2.69108
492	242064	119095488	22.1811	7.8944	2.69197
493	243049	119823157	22.2036	7.8998	2.69285
494	244036	120553784	22.2261	7.9051	2.69373
495	245025	121287375	22.2486	7.9105	2.69461
496	246016	122023936	22.2711	7.9158	2.69548
497	247009	122763473	22.2935	7.9211	2.69636
498	248004	123505992	22.3159	7.9264	2.69723
499	249001	124251499	22.3383	7.9317	2.69810
500	250000	125000000	22.3607	7.9370	2.69897

NATURAL SINES AND COSINES

Degrees	MINUTES											
	0′		10′		20′		30′		40′		50′	
	Sine	Cos.	Sine	Cos.	Sine	Cos.	Sine	Cos.	Sine	Cos.	Sine	Cos.
0	.00000	1.00000	.00291	1.00000	.00582	.99998	.00873	.99996	.01164	.99993	.01454	.99989
1	.01745	.99985	.02036	.99979	.02327	.99973	.02618	.99966	.02908	.99958	.03199	.99949
2	.03490	.99939	.03781	.99929	.04071	.99917	.04362	.99905	.04653	.99892	.04943	.99878
3	.05234	.99863	.05524	.99847	.05814	.99831	.06105	.99813	.06395	.99795	.06685	.99776
4	.06976	.99756	.07266	.99736	.07556	.99714	.07846	.99692	.08136	.99668	.08426	.99644
5	.08716	.99619	.09005	.99594	.09295	.99567	.09585	.99540	.09874	.99511	.10164	.99482
6	.10453	.99452	.10742	.99421	.11031	.99390	.11320	.99357	.11609	.99324	.11898	.99290
7	.12187	.99255	.12476	.99219	.12764	.99182	.13053	.99144	.13341	.99106	.13629	.99067
8	.13917	.99027	.14205	.98986	.14493	.98944	.14781	.98902	.15069	.98858	.15356	.98814
9	.15643	.98769	.15931	.98723	.16218	.98676	.16505	.98629	.16792	.98580	.17078	.98531
10	.17365	.98481	.17651	.98430	.17937	.98378	.18224	.98325	.18509	.98272	.18795	.98218
11	.19081	.98163	.19366	.98107	.19652	.98050	.19937	.97992	.20222	.97934	.20507	.97875
12	.20791	.97815	.21076	.97754	.21360	.97692	.21644	.97630	.21928	.97566	.22212	.97502
13	.22495	.97437	.22778	.97371	.23062	.97304	.23345	.97237	.23627	.97169	.23910	.97100
14	.24192	.97030	.24474	.96959	.24756	.96887	.25038	.96815	.25320	.96742	.25601	.96667
15	.25882	.96593	.26163	.96517	.26443	.96440	.26724	.96363	.27004	.96285	.27284	.96206
16	.27564	.96126	.27843	.96046	.28123	.95964	.28402	.95882	.28680	.95799	.28959	.95715
17	.29237	.95630	.29515	.95545	.29793	.95459	.30071	.95372	.30348	.95284	.30625	.95195
18	.30902	.95106	.31178	.95015	.31454	.94924	.31730	.94832	.32006	.94740	.32282	.94646
19	.32557	.94552	.32832	.94457	.33106	.94361	.33381	.94264	.33655	.94167	.33929	.94068
20	.34202	.93969	.34475	.93869	.34748	.93769	.35021	.93667	.35293	.93565	.35565	.93462
21	.35837	.93358	.36108	.93253	.36379	.93148	.36650	.93042	.36921	.92935	.37191	.92827
22	.37461	.92718	.37730	.92609	.37999	.92499	.38268	.92388	.38537	.92276	.38805	.92164
23	.39073	.92050	.39341	.91936	.39608	.91822	.39875	.91706	.40142	.91590	.40408	.91472
24	.40674	.91355	.40939	.91236	.41204	.91116	.41469	.90996	.41734	.90875	.41998	.90753
25	.42262	.90631	.42525	.90507	.42788	.90383	.43051	.90259	.43313	.90133	.43575	.90007

NATURAL SINES AND COSINES

Degrees	MINUTES											
	0′		10′		20′		30′		40′		50′	
	Sine	Cos.	Sine	Cos.	Sine	Cos.	Sine	Cos.	Sine	Cos.	Sine	Cos.
26	.43837	.89879	.44098	.89752	.44359	.89623	.44620	.89493	.44880	.89363	.45140	.89232
27	.45399	.89101	.45658	.88968	.45917	.88835	.46175	.88701	.46433	.88566	.46690	.88431
28	.46947	.88295	.47204	.88158	.47460	.88020	.47716	.87882	.47971	.87743	.48226	.87603
29	.48481	.87462	.48735	.87321	.48989	.87178	.49242	.87036	.49495	.86892	.49748	.86748
30	.50000	.86603	.50252	.86457	.50503	.86310	.50754	.86163	.51004	.86015	.51254	.85866
31	.51504	.85717	.51753	.85567	.52002	.85416	.52250	.85264	.52498	.85112	.52745	.84959
32	.52992	.84805	.53238	.84650	.53484	.84495	.53730	.84339	.53975	.84182	.54220	.84025
33	.54464	.83867	.54708	.83708	.54951	.83549	.55194	.83389	.55436	.83228	.55678	.83066
34	.55919	.82904	.56160	.82741	.56401	.82577	.56641	.82413	.56880	.82248	.57119	.82082
35	.57358	.81915	.57596	.81748	.57833	.81580	.58070	.81412	.58307	.81242	.58543	.81072
36	.58779	.80902	.59014	.80730	.59248	.80558	.59482	.80386	.59716	.80212	.59949	.80038
37	.60182	.79864	.60414	.79688	.60645	.79512	.60876	.79335	.61107	.79158	.61337	.78980
38	.61566	.78801	.61795	.78622	.62024	.78442	.62251	.78261	.62479	.78079	.62706	.77897
39	.62932	.77715	.63158	.77531	.63383	.77347	.63608	.77162	.63832	.76977	.64056	.76791
40	.64279	.76604	.64501	.76417	.64723	.76229	.64945	.76041	.65166	.75851	.65386	.75661
41	.65606	.75471	.65825	.75280	.66044	.75088	.66262	.74896	.66480	.74703	.66697	.74509
42	.66913	.74314	.67129	.74120	.67344	.73924	.67559	.73728	.67773	.73531	.67987	.73333
43	.68200	.73135	.68412	.72937	.68624	.72737	.68835	.72537	.69046	.72337	.69256	.72136
44	.69466	.71934	.69675	.71732	.69883	.71529	.70091	.71325	.70298	.71121	.70505	.70916
45	.70711	.70711										

NATURAL TANGENTS AND COTANGENTS

Degrees	0′		10′		20′		30′		40′		50′	
	MINUTES											
	Tang.	Cotang.	Tang.	Cotang.	Tang.	Cotang.	Tang.	Cotang.	Tang.	Cotang.	Tang.	Cotang.
0	.00000	Infinite	.00291	343.774	.00582	171.885	.00873	114.589	.01164	85.9398	.01455	68.7501
1	.01746	57.2900	.02036	49.1039	.02328	42.9641	.02619	38.1885	.02910	34.3678	.03201	31.2416
2	.03492	28.6363	.03783	26.4316	.04075	24.5418	.04366	22.9038	.04658	21.4704	.04949	20.2056
3	.05241	19.0811	.05533	18.0750	.05824	17.1693	.06116	16.3499	.06408	15.6048	.06700	14.9244
4	.06993	14.3007	.07285	13.7267	.07578	13.1969	.07870	12.7062	.08163	12.2505	.08456	11.8262
5	.08749	11.4301	.09042	11.0594	.09335	10.7119	.09629	10.3854	.09923	10.0780	.10216	9.78817
6	.10510	9.51436	.10805	9.25530	.11099	9.00983	.11394	8.77689	.11688	8.55555	.11983	8.34496
7	.12278	8.14435	.12574	7.95302	.12869	7.77035	.13165	7.59575	.13461	7.42871	.13758	7.26873
8	.14054	7.11537	.14351	6.96823	.14648	6.82694	.14945	6.69116	.15243	6.56055	.15540	6.43484
9	.15838	6.31375	.16137	6.19703	.16435	6.08444	.16734	5.97576	.17033	5.87080	.17333	5.76937
10	.17633	5.67128	.17933	5.57638	.18233	5.48451	.18534	5.39552	.18835	5.30928	.19136	5.22566
11	.19438	5.14455	.19740	5.06584	.20042	4.98940	.20345	4.91516	.20648	4.84300	.20952	4.77286
12	.21256	4.70463	.21560	4.63825	.21864	4.57363	.22169	4.51071	.22475	4.44942	.22781	4.38969
13	.23087	4.33148	.23393	4.27471	.23700	4.21933	.24008	4.16530	.24316	4.11256	.24624	4.06107
14	.24933	4.01078	.25242	3.96165	.25552	3.91364	.25862	3.86671	.26172	3.82083	.26483	3.77595
15	.26795	3.73205	.27107	3.68909	.27419	3.64705	.27732	3.60588	.28046	3.56557	.28360	3.52609
16	.28675	3.48741	.28990	3.44951	.29305	3.41236	.29621	3.37594	.29938	3.34023	.30255	3.30521
17	.30573	3.27085	.30891	3.23714	.31210	3.20406	.31530	3.17159	.31850	3.13972	.32171	3.10842
18	.32492	3.07768	.32814	3.04749	.33136	3.01783	.33460	2.98869	.33783	2.96004	.34108	2.93189
19	.34433	2.90421	.34758	2.87700	.35085	2.85023	.35412	2.82391	.35740	2.79802	.36068	2.77254
20	.36397	2.74748	.36727	2.72281	.37057	2.69853	.37388	2.67462	.37720	2.65109	.38053	2.62791
21	.38386	2.60509	.38721	2.58261	.39055	2.56046	.39391	2.53865	.39727	2.51715	.40065	2.49597
22	.40403	2.47509	.40741	2.45451	.41081	2.43422	.41421	2.41421	.41763	2.39449	.42105	2.37504
23	.42447	2.35585	.42791	2.33693	.43136	2.31826	.43481	2.29984	.43828	2.28167	.44175	2.26374
24	.44523	2.24604	.44872	2.22857	.45222	2.21132	.45573	2.19430	.45924	2.17749	.46277	2.16090
25	.46631	2.14451	.46985	2.12832	.47341	2.11233	.47698	2.09654	.48055	2.08094	.48414	2.06553

NATURAL TANGENTS AND COTANGENTS

Degrees	MINUTES											
	0′		10′		20′		30′		40′		50′	
	Tang.	Cotang.	Tang.	Cotang.	Tang.	Cotang.	Tang.	Cotang.	Tang.	Cotang.	Tang.	Cotang.
26	.48773	2.05030	.49134	2.03526	.49495	2.02039	.49858	2.00569	.50222	1.99116	.50587	1.97680
27	.50953	1.96261	.51320	1.94858	.51688	1.93470	.52057	1.92098	.52427	1.90741	.52798	1.89400
28	.53171	1.88073	.53545	1.86760	.53920	1.85462	.54296	1.84177	.54674	1.82907	.55051	1.81649
29	.55431	1.80405	.55812	1.79174	.56194	1.77955	.56577	1.76749	.56962	1.75556	.57348	1.74375
30	.57735	1.73205	.58124	1.72047	.58513	1.70901	.58905	1.69766	.59297	1.68643	.59691	1.67530
31	.60086	1.66428	.60483	1.65337	.60881	1.64256	.61280	1.63185	.61681	1.62125	.62083	1.61074
32	.62487	1.60033	.62892	1.59002	.63299	1.57981	.63707	1.56969	.64117	1.55966	.64528	1.54972
33	.64941	1.53987	.65355	1.53010	.65771	1.52043	.66189	1.51084	.66608	1.50133	.67028	1.49190
34	.67451	1.48256	.67875	1.47330	.68301	1.46411	.68728	1.45501	.69157	1.44598	.69588	1.43703
35	.70021	1.42815	.70455	1.41934	.70891	1.41061	.71329	1.40195	.71769	1.39336	.72211	1.38484
36	.72654	1.37638	.73100	1.36800	.73547	1.35968	.73996	1.35142	.74447	1.34323	.74900	1.33511
37	.75355	1.32704	.75812	1.31904	.76272	1.31110	.76733	1.30323	.77196	1.29541	.77661	1.28764
38	.78129	1.27994	.78598	1.27230	.79070	1.26471	.79544	1.25717	.80020	1.24969	.80498	1.24227
39	.80978	1.23490	.81461	1.22758	.81946	1.22031	.82434	1.21310	.82923	1.20593	.83415	1.19882
40	.83910	1.19175	.84407	1.18474	.84906	1.17777	.85408	1.17085	.85912	1.16398	.86419	1.15715
41	.86929	1.15037	.87441	1.14363	.87955	1.13694	.88473	1.13029	.88992	1.12369	.89515	1.11713
42	.90040	1.11061	.90569	1.10414	.91099	1.09770	.91633	1.09131	.92170	1.08496	.92709	1.07864
43	.93252	1.07237	.93797	1.06613	.94345	1.05994	.94896	1.05378	.95451	1.04766	.96008	1.04158
44	.96569	1.03553	.97133	1.02952	.97700	1.02355	.98270	1.01761	.98843	1.01170	.99420	1.00583
45	1.00000	1.00000										

LOGARITHMIC SINES, COSINES TANGENTS, AND COTANGENTS,

Logarithms indicated in Form 9. (value of log.)—10.

Angle	Sine	Cosine	Tangent	Cotangent	M
0°00′	Inf. Neg.	0.000000	Inf. Neg.	Infinite	60
0°30′	7.940842	9.999983	7.940858	12.059142	30
1°00′	8.241855	9.999934	8.241921	11.758079	60
1°30′	8.417919	9.999851	8.418068	11.581932	30
2°00′	8.542819	9.999735	8.543084	11.456916	60
2°30′	8.639680	9.999586	8.640093	11.359907	30
3°00′	8.718800	9.999404	8.719396	11.280604	60
3°30′	8.785675	9.999189	8.786486	11.213514	30
4°00′	8.843585	9.998941	8.844644	11.155356	60
4°30′	8.894643	9.998659	8.895984	11.104016	30
5°00′	8.940296	9.998344	8.941952	11.058048	60
5°30′	8.981573	9.997996	8.983577	11.016423	30
6°00′	9.019235	9.997614	9.021620	10.978380	60
6°30′	9.053859	9.997199	9.056659	10.943341	30
7°00′	9.085894	9.996751	9.089144	10.910856	60
7°30′	9.115698	9.996269	9.119429	10.880571	30
8°00′	9.143555	9.995753	9.147803	10.852197	60
8°30′	9.169702	9.995203	9.174499	10.825501	30
9°00′	9.194332	9.994620	9.199713	10.800287	60
9°30′	9.217609	9.994003	9.223607	10.776393	30
10°00′	9.239670	9.993351	9.246319	10.753681	60
10°30′	9.260633	9.992666	9.267967	10.732033	30
11°00′	9.280599	9.991947	9.288652	10.711348	60
11°30′	9.299655	9.991193	9.308463	10.691537	30
12°00′	9.317879	9.990404	9.327475	10.672525	60
12°30′	9.335337	9.989582	9.345755	10.654245	30
13°00′	9.352088	9.988724	9.363364	10.636636	60
13°30′	9.368185	9.987832	9.380354	10.619646	30
14°00′	9.383675	9.986904	9.396771	10.603229	60
14°30′	9.398600	9.985942	9.412658	10.587342	30
15°00′	9.412996	9.984944	9.428052	10.571948	60
15°30′	9.426899	9.983911	9.442988	10.557012	30
16°00′	9.440338	9.982842	9.457496	10.542504	60
16°30′	9.453342	9.981737	9.471605	10.528395	30
17°00′	9.465935	9.980596	9.485339	10.514661	60
17°30′	9.478142	9.979420	9.498722	10.501278	30
18°00′	9.489982	9.978206	9.511776	10.488224	60
18°30′	9.501476	9.976957	9.524520	10.475480	30
19°00′	9.512642	9.975670	9.536972	10.463028	60
19°30′	9.523495	9.974347	9.549149	10.450851	30
20°00′	9.534052	9.972986	9.561066	10.438934	60
20°30′	9.544325	9.971588	9.572738	10.427262	30
21°00′	9.554329	9.970152	9.584177	10.415823	60
21°30′	9.564075	9.968678	9.595398	10.404602	30
22°00′	9.573575	9.967166	9.606410	10.393590	60

LOGARITHMIC SINES, COSINES, TANGENTS AND COTANGENTS—Continued

Logarithms indicated in Form 9. (value of log.)—10.

Angle	Sine	Cosine	Tangent	Cotangent	M
22°30′	9.582840	9.965615	9.617224	10.382776	30
23°00′	9.591878	9.964026	9.627852	10.372148	60
23°30′	9.600700	9.962398	9.638302	10.361698	30
24°00′	9.609313	9.960730	9.648583	10.351417	60
24°30′	9.617727	9.959023	9.658704	10.341296	30
25°00′	9.625948	9.957276	9.668673	10.331327	60
25°30′	9.633984	9.955488	9.678496	10.321504	30
26°00′	9.641842	9.953660	9.688182	10.311818	60
26°30′	9.649527	9.951791	9.697736	10.302264	30
27°00′	9.657047	9.949881	9.707166	10.292834	60
27°30′	9.664406	9.947929	9.716477	10.283523	30
28°00′	9.671609	9.945935	9.725674	10.274326	60
28°30′	9.678663	9.943899	9.734764	10.265236	30
29°00′	9.685571	9.941819	9.743752	10.256248	60
29°30′	9.692339	9.939697	9.752642	10.247358	30
30°00′	9.698970	9.937531	9.761439	10.238561	60
30°30′	9.705469	9.935320	9.770148	10.229852	30
31°00′	9.711839	9.933066	9.778774	10.221226	60
31°30′	9.718085	9.930766	9.787319	10.212681	30
32°00′	9.724210	9.928420	9.795789	10.204211	60
32°30′	9.730217	9.926029	9.804187	10.195813	30
33°00′	9.736109	9.923591	9.812517	10.187483	60
33°30′	9.741889	9.921107	9.820783	10.179217	30
34°00′	9.747562	9.918574	9.828987	10.171013	60
34°30′	9.753128	9.915994	9.837134	10.162866	30
35°00′	9.758591	9.913365	9.845227	10.154773	60
35°30′	9.763954	9.910686	9.853268	10.146732	30
36°00′	9.769219	9.907958	9.861261	10.138739	60
36°30′	9.774388	9.905179	9.869209	10.130791	30
37°00′	9.779463	9.902349	9.877114	10.122886	60
37°30′	9.784447	9.899467	9.884980	10.115020	30
38°00′	9.789342	9.896532	9.892810	10.107190	60
38°30′	9.794150	9.893544	9.900605	10.099395	30
39°00′	9.798872	9.890503	9.908369	10.091631	60
39°30′	9.803511	9.887406	9.916104	10.083896	30
40°00′	9.808067	9.884254	9.923814	10.076186	60
40°30′	9.812544	9.881046	9.931499	10.068501	30
41°00′	9.816943	9.877780	9.939163	10.060837	60
41°30′	9.821265	9.874456	9.946808	10.053192	30
42°00′	9.825511	9.871073	9.954437	10.045563	60
42°30′	9.829683	9.867631	9.962052	10.037948	30
43°00′	9.833783	9.864127	9.969656	10.030344	60
43°30′	9.837812	9.860562	9.977250	10.022750	30
44°00′	9.841771	9.856934	9.984837	10.015163	60
44°30′	9.845662	9.853242	9.992420	10.007580	30
45°00′	9.849485	9.849485	10.000000	.000000	0

ELEMENTS OF STRUCTURAL BEAMS

(Carnegie Steel Co., Pocket Companion, 21st Edition)

Section Index	Depth of Beam	Weight per Foot	Area of Section	Width of Flange	Thickness of Web	Axis 1-1			Axis 2-2		
						I	r	S	I	r	S
	In.	Lbs.	In.^{2}	In.	In.	In.^{4}	In.	In.^{3}	In.^{4}	In.	In.^{3}
B 61	27	90.0	26.33	9.000	0.524	2958.3	10.60	219.1	75.3	1.69	16.7
		115.0	33.98	8.000	0.750	2955.5	9.33	246.3	83.2	1.57	20.8
B 24	24	110.0	32.48	7.938	0.688	2883.5	9.42	240.3	81.0	1.58	20.4
		105.9	30.98	7.875	0.625	2811.5	9.53	234.3	78.9	1.60	20.0
		100.0	29.41	7.254	0.754	2379.6	9.00	198.3	48.6	1.28	13.4
		95.0	27.94	7.193	0.693	2309.0	9.09	192.4	47.1	1.30	13.1
B 1	24	90.0	26.47	7.131	0.631	2238.4	9.20	186.5	45.7	1.31	12.8
		85.0	25.00	7.070	0.570	2167.8	9.31	180.7	44.4	1.33	12.6
		79.9	23.32	7.000	0.500	2087.2	9.46	173.9	42.9	1.36	12.3
B 62	24	74.0	21.70	9.000	0.476	1950.1	9.48	162.5	61.2	1.68	13.6
B 63	21	60.5	17.68	8.250	0.428	1235.5	8.36	117.7	43.5	1.57	10.06
		100.0	29.41	7.284	0.884	1655.6	7.50	165.6	52.7	1.34	14.5
		95.0	27.94	7.210	0.810	1606.6	7.58	160.7	50.8	1.35	14.1
B 2	20	90.0	26.47	7.137	0.737	1557.6	7.67	155.8	49.0	1.36	13.7
		85.0	25.00	7.063	0.663	1508.5	7.77	150.9	47.3	1.37	13.4
		81.4	23.73	7.000	0.600	1466.3	7.86	146.6	45.8	1.39	13.1
		75.0	22.06	6.399	0.649	1268.8	7.58	126.9	30.3	1.17	9.5
B 3	20	70.0	20.59	6.325	0.575	1219.8	7.70	122.0	29.0	1.19	9.2
		65.4	19.08	6.250	0.500	1169.5	7.83	117.0	27.9	1.21	8.9
		90.0	26.47	7.245	0.807	1260.4	6.90	140.0	52.0	1.40	14.4
B 81	18	85.0	25.00	7.163	0.725	1220.7	6.99	135.6	50.0	1.42	14.0
		80.0	23.53	7.082	0.644	1181.0	7.09	131.2	48.1	1.43	13.6
		75.0	22.05	7.000	0.562	1141.3	7.19	126.8	46.2	1.45	13.2
		70.0	20.59	6.259	0.719	921.2	6.69	102.4	24.6	1.09	7.9
B 80	18	65.0	19.12	6.177	0.637	881.5	6.79	97.9	23.5	1.11	7.6
		60.0	17.65	6.095	0.555	841.8	6.91	93.5	22.4	1.13	7.3
		54.7	15.93	6.000	0.460	795.6	7.07	88.4	21.2	1.15	7.1
B 64	18	48.0	14.08	7.500	0.380	737.1	7.23	81.9	30.0	1.46	8.0
		75.0	22.06	6.292	0.882	691.2	5.60	92.2	30.7	1.18	9.8
B 5	15	70.0	20.59	6.194	0.784	663.7	5.68	88.5	29.0	1.19	9.4
		65.0	19.12	6.096	0.686	636.1	5.77	84.8	27.4	1.20	9.0
		60.8	17.67	6.000	0.590	609.0	5.87	81.2	26.0	1.21	8.7
		55.0	16.18	5.746	0.656	511.0	5.62	68.1	17.1	1.02	5.9
B 7	15	50.0	14.71	5.648	0.558	483.4	5.73	64.5	16.0	1.04	5.7
		45.0	13.24	5.550	0.460	455.9	5.87	60.8	15.1	1.07	5.4
		42.9	12.48	5.500	0.410	441.8	5.95	58.9	14.6	1.08	5.3
B 65	15	37.5	10.91	6.750	0.332	405.5	6.10	54.1	19.9	1.35	5.9

ELEMENTS OF STRUCTURAL BEAMS—Concluded

(Carnegie Steel Co., Pocket Companion, 21st Edition)

Section Index	Depth of Beam	Weight per Foot	Area of Section	Width of Flange	Thickness of Web	Axis 1-1			Axis 2-2		
						I	r	S	I	r	S
	In.	Lbs.	In.²	In.	In.	In.⁴	In.	In.³	In.⁴	In.	In.³
B 8	12	55.0	16.18	5.611	0.821	321.0	4.45	53.5	17.5	1.04	6.2
		50.0	14.71	5.489	0.699	303.4	4.54	50.6	16.1	1.05	5.9
		45.0	13.24	5.366	0.576	285.7	4.65	47.6	14.9	1.06	5.6
		40.8	11.84	5.250	0.460	269.0	4.77	44.8	13.8	1.08	5.3
B 9	12	35.0	10.29	5.086	0.436	228.3	4.71	38.0	10.1	0.99	4.0
		31.8	9.26	5.000	0.350	215.8	4.83	36.0	9.5	1.01	3.8
B 66	12	28.0	8.15	6.000	0.284	199.4	4.95	33.2	12.6	1.24	4.2
B 11	10	40.0	11.76	5.099	0.749	158.7	3.67	31.7	9.5	0.90	3.7
		35.0	10.29	4.952	0.602	146.4	3.77	29.3	8.5	0.91	3.4
		30.0	8.82	4.805	0.455	134.2	3.90	26.8	7.7	0.93	3.2
		25.4	7.37	4.660	0.310	122.1	4.07	24.4	6.9	0.97	3.0
B 67	10	22.25	6.54	5.500	0.252	113.6	4.17	22.7	9.0	1.17	3.3
B 13	9	35.0	10.29	4.772	0.732	111.8	3.29	24.8	7.3	0.84	3.1
		30.0	8.82	4.609	0.569	101.9	3.40	22.6	6.4	0.85	2.8
		25.0	7.35	4.446	0.406	91.9	3.54	20.4	5.7	0.88	2.5
		21.8	6.31	4.330	0.290	84.9	3.67	18.9	5.2	0.90	2.4
B 15	8	25.5	7.50	4.271	0.541	68.4	3.02	17.1	4.8	0.80	2.2
		23.0	6.76	4.179	0.449	64.5	3.09	16.1	4.4	0.81	2.1
		20.5	6.03	4.087	0.357	60.6	3.17	15.2	4.1	0.82	2.0
		18.4	5.33	4.000	0.270	56.9	3.27	14.2	3.8	0.84	1.9
B 68	8	17.5	5.12	5.000	0.220	58.4	3.38	14.6	6.2	1.10	2.5
B 17	7	20.0	5.88	3.868	0.458	42.2	2.68	12.1	3.2	0.74	1.7
		17.5	5.15	3.763	0.353	39.2	2.76	11.2	2.9	0.76	1.6
		15.3	4.42	3.660	0.250	36.2	2.86	10.4	2.7	0.78	1.5
B 19	6	17.25	5.07	3.575	0.475	26.2	2.27	8.7	2.4	0.68	1.3
		14.75	4.34	3.452	0.352	24.0	2.35	8.0	2.1	0.69	1.2
		12.50	3.61	3.330	0.230	21.8	2.46	7.3	1.9	0.72	1.1
B 21	5	14.75	4.34	3.294	0.504	15.2	1.87	6.1	1.7	0.63	1.0
		12.25	3.60	3.147	0.357	13.6	1.94	5.5	1.5	0.63	0.92
		10.00	2.87	3.000	0.210	12.1	2.05	4.8	1.2	0.65	0.82
B 23	4	10.5	3.09	2.880	0.410	7.1	1.52	3.6	1.0	0.57	0.70
		9.5	2.79	2.807	0.337	6.8	1.55	3.4	0.93	0.58	0.66
		8.5	2.50	2.733	0.263	6.4	1.59	3.2	0.85	0.58	0.62
		7.7	2.21	2.660	0.190	6.0	1.64	3.0	0.77	0.59	0.58
B 77	3	7.5	2.21	2.521	0.361	2.9	1.15	1.9	0.60	0.52	0.48
		6.5	1.91	2.423	0.263	2.7	1.19	1.8	0.53	0.52	0.44
		5.7	1.63	2.330	0.170	2.5	1.23	1.7	0.46	0.53	0.40

I-BEAMS—ALLOWABLE UNIFORM LOAD IN POUNDS PER FOOT

(Carnegie Steel Co., Pocket Companion, 21st Edition)

Depth, Inches	Pounds per Foot	Span in Feet									
		10	12	14	16	18	20	22	24	26	30
27	90	23340	16210	11910	9120	7200	5840	4820	4050	3450	2590
	115	26270	18240	13400	10260	8110	6570	5430	4560	3890	2920
	110	25630	17800	13080	10010	7910	6410	5300	4450	3790	2850
	105	24990	17360	12750	9760	7710	6250	5160	4340	3700	2780
	100	21150	14690	10790	8260	6530	5290	4370	3670	3130	2350
24	95	20520	14250	10470	8020	6340	5130	4240	3560	3040	2280
	90	19900	13820	10150	7770	6140	4970	4110	3450	2940	2210
	85	19270	13380	9830	7530	5950	4820	3980	3350	2850	2140
	79.9	18550	12880	9470	7250	5730	4640	3830	3220	2750	2060
	74	17330	12040	8840	6770	5350	4330	3580	3010	2560	1930
21	60.5	12550	8720	6400	4900	3870	3140	2590	2180	1860	1400
	100	17660	12260	9010	6900	5450	4420	3650	3070	2610	1960
	95	17140	11900	8740	6690	5290	4280	3540	2980	2540	1900
	90	16610	11540	8480	6490	5130	4150	3430	2880	2460	1850
	85	16090	11170	8210	6290	4970	4020	3320	2790	2380	1790
20	81.4	15640	10860	7980	6110	4830	3910	3230	2720	2310	1740
	75	13530	9400	6910	5290	4180	3380	2800	2350	2000	1500
	70	13010	9040	6640	5080	4020	3250	2690	2260	1920	1450
	65.4	12480	8660	6370	4870	3850	3120	2580	2170	1850	1390
	90	14940	10370	7620	5840	4610	3730	3090	2590	2210	1660
	85	14470	10050	7380	5650	4470	3620	2990	2510	2140	1610
	80	14000	9720	7140	5470	4320	3500	2890	2430	2070	1560
	75	13530	9390	6900	5280	4180	3380	2800	2350	2000	1500
18	70	10920	7580	5570	4260	3370	2730	2260	1900	1620	1210
	65	10450	7260	5330	4080	3220	2610	2160	1810	1550	1160
	60	9980	6930	5090	3900	3080	2490	2060	1730	1480	1110
	54.7	9430	6550	4810	3680	2910	2360	1950	1640	1400	1050
	48	8740	6070	4460	3410	2700	2180	1800	1520	1290	970

I-BEAMS—ALLOWABLE UNIFORM LOAD IN POUNDS PER FOOT

(Carnegie Steel Co., Pocket Companion, 21st Edition)

Depth, Inches	Pounds per Foot	Span in Feet															
		6	8	10	12	14	16	18	19	20	21	22	23	24	25	26
	75	27310	15360	9830	6830	5020	3840	3030	2720	2460	2230	2030	1860	1710	1570	1450
	70	26220	14750	9440	6550	4820	3690	2910	2610	2360	2140	1950	1780	1640	1510	1400
	65	25130	14140	9050	6280	4620	3530	2790	2510	2260	2050	1870	1710	1570	1450	1340
	60.8	24060	13530	8660	6010	4420	3380	2670	2400	2170	1960	1790	1640	1500	1390	1280
15	55	20190	11360	7270	5050	3710	2840	2240	2010	1820	1650	1500	1370	1260	1160	1080
	50	19100	10740	6880	4780	3510	2690	2120	1910	1720	1560	1420	1300	1190	1100	1020
	45	18010	10130	6480	4500	3310	2530	2000	1800	1620	1470	1340	1230	1130	1040	960
	42.9	17450	9820	6280	4360	3210	2450	1940	1740	1570	1430	1300	1190	1090	1010	930
	37.5	16020	9010	5770	4010	2940	2250	1780	1600	1440	1310	1190	1090	1000	920	850
	55	15850	8920	5710	3960	2910	2230	1760	1580	1430	1290	1180	1080	990	910	840
	50	14980	8430	5390	3750	2750	2110	1660	1490	1350	1220	1110	1020	940	860	800
	45	14110	7940	5080	3530	2590	1980	1570	1410	1270	1150	1050	960	880	810	750
12	40.8	13280	7470	4780	3320	2440	1870	1480	1320	1200	1080	990	900	830	770	710
	35	11270	6340	4060	2820	2070	1580	1250	1120	1020	920	840	770	700	650	600
	31.8	10660	6000	3840	2660	1960	1500	1180	1060	960	870	790	730	670	610	570
	28	9850	5540	3550	2460	1810	1390	1090	980	890	800	730	670	620	570	520
	40	9400	5290	3390	2350	1730	1320	1040	940	850	770	700				
	35	8680	4880	3120	2170	1590	1220	960	870	780	710	650				
10	30	7950	4470	2860	1990	1460	1120	880	790	720	650	590				
	25.4	7240	4070	2610	1810	1330	1020	800	720	650	590	540				
	22.25	6730	3790	2420	1680	1240	950	750	670	610	550	500				
	35	7360	4140	2650	1840	1350	1040	820	730	660						
	30	6710	3770	2420	1680	1230	940	750	670	600						
9	25	6050	3410	2180	1510	1110	850	670	600	540						
	21.8	5590	3150	2010	1400	1030	790	620	560	500						

Loads below dotted horizontal lines will produce excessive deflection.

I-BEAMS—ALLOWABLE UNIFORM LOAD IN POUNDS PER FOOT

(Carnegie Steel Co., Pocket Companion, 21st Edition)

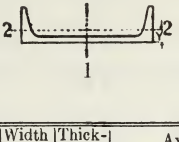
Depth, Inches	Pounds per foot	Span in Feet																				
		2	2½	3	3½	4	4½	5	5½	6	6½	7	8	9	10	11	12	13	14	15	16	17	18
8	25.5	43280	29200	20280	14900	11410	9010	7300	6030	5070	4320	3720	2850	2250	1830	1510	1270	1080	930	810	710	630	560
	23.	35920	27520	19110	14040	10750	8490	6880	5690	4780	4070	3510	2690	2120	1720	1420	1190	1020	880	760	670	600	530
	20.5	28560	22840	17950	13190	10100	7980	6460	5340	4490	3820	3300	2520	1990	1620	1340	1120	960	820	720	630	560	500
	18.4	21600	17280	14400	12340	9480	7490	6070	5010	4210	3590	3100	2370	1870	1520	1250	1050	900	770	670	590	530	470
	17.5	17600	14080	11730	10060	8800	7690	6230	5150	4320	3680	3180	2430	1920	1560	1290	1080	920	790	690	610	540	480
7	20.	32060	20570	14280	10490	8040	6350	5140	4250	3570	3040	2620	2010	1590	1290	1060	890	760	660	570	500		
	17.5	24710	19100	13270	9750	7460	5900	4780	3950	3320	2830	2440	1870	1470	1190	990	830	710	610	530	470		
	15.3	17500	14000	11700	9010	6900	5450	4420	3650	3070	2610	2250	1730	1360	1100	910	770	650	560	490	430		
6	17.25	23280	14900	10350	7600	5820	4600	3720	3080	2590	2200	1900	1450	1150	930	770	650	550	480				
	14.75	21120	13650	9470	6960	5330	4210	3410	2820	2370	2020	1740	1330	1050	850	700	590	500	440				
	12.5	13800	11040	8610	6320	4840	3830	3100	2560	2150	1830	1580	1210	960	780	640	540	460	400				
5	14.75	16160	10340	7180	5280	4040	3190	2590	2140	1800	1530	1320	1010	800	650	530	450						
	12.25	14530	9300	6460	4740	3630	2870	2320	1920	1610	1380	1190	910	720	580	480	400						
	10.00	10500	8250	5730	4210	3220	2550	2060	1710	1430	1220	1050	810	640	520	430	360						
4	10.5	9520	6090	4230	3110	2380	1880	1520	1260	1060	900	780	590	470	380								
	9.5	9000	5760	4000	2940	2250	1780	1440	1190	1000	850	730	560	440	360								
	8.5	8470	5420	3770	2770	2120	1670	1360	1120	940	800	690	530	420	340								
	7.7	7600	5090	3530	2600	1990	1570	1270	1050	880	750	650	500	390	320								
3	7.5	5180	3310	2300	1690	1290	1020	830	680	580	490	420											
	6.5	4780	3060	2130	1560	1200	940	770	630	530	450	390											
	5.7	4410	2820	1960	1440	1100	870	710	580	490	420	360											

Loads within heavy horizontal lines are maximum loads for web shear.

Loads below dotted horizontal lines will produce excessive deflection.

ELEMENTS OF STRUCTURAL CHANNELS

(Carnegie Steel Co. ,Pocket Companion, 21st Edition)



Section Index	Depth of Channel	Weight per Foot	Area of Section	Width of Flange	Thickness of Web	Axis 1-1			Axis 2-2			y
						I	r	S	I	r	S	
	In.	Lbs.	In.^{2}	In.	In.	In.^{4}	In.	In.^{3}	In.^{4}	In.	In.^{3}	In.
		55.0	16.18	3.818	0.818	430.2	5.16	57.4	12.2	0.87	4.1	0.82
		50.0	14.71	3.720	0.720	402.7	5.23	53.7	11.2	0.87	3.8	0.80
C 1	15	45.0	13.24	3.622	0.622	375.1	5.32	50.0	10.3	0.88	3.6	0.79
		40.0	11.76	3.524	0.524	347.5	5.43	46.3	9.4	0.89	3.4	0.78
		35.0	10.29	3.426	0.426	319.9	5.58	42.7	8.5	0.91	3.2	0.79
		33.9	9.90	3.400	0.400	312.6	5.62	41.7	8.2	0.91	3.2	0.79
		40.0	11.76	3.418	0.758	196.9	4.09	32.8	6.6	0.75	2.5	0.72
		35.0	10.29	3.296	0.636	179.3	4.17	29.9	5.9	0.76	2.3	0.69
C 2	12	30.0	8.82	3.173	0.513	161.7	4.28	26.9	5.2	0.77	2.1	0.68
		25.0	7.35	3.050	0.390	144.0	4.43	24.0	4.5	0.79	1.9	0.68
		20.7	6.03	2.940	0.280	128.1	4.61	21.4	3.9	0.81	1.7	0.70
		35.0	10.29	3.183	0.823	115.5	3.35	23.1	4.7	0.67	1.9	0.70
		30.0	8.82	3.036	0.676	103.2	3.42	20.7	4.0	0.67	1.7	0.65
C 3	10	25.0	7.35	2.889	0.529	91.0	3.52	18.2	3.4	0.68	1.5	0.62
		20.0	5.88	2.742	0.382	78.7	3.66	15.7	2.9	0.70	1.3	0.61
		15.3	4.46	2.600	0.240	66.9	3.87	13.4	2.3	0.72	1.2	0.64
		25.0	7.35	2.815	0.615	70.7	3.10	15.7	3.0	0.64	1.4	0.62
C 4	9	20.0	5.88	2.652	0.452	60.8	3.21	13.5	2.5	0.65	1.2	0.59
		15.0	4.41	2.488	0.288	50.9	3.40	11.3	2.0	0.67	1.0	0.59
		13.4	3.89	2.430	0.230	47.3	3.49	10.5	1.8	0.67	0.97	0.61
		21.25	6.25	2.622	0.582	47.8	2.77	11.9	2.3	0.60	1.1	0.59
		18.75	5.51	2.530	0.490	43.8	2.82	11.0	2.0	0.60	1.0	0.57
C 5	8	16.25	4.78	2.439	0.399	39.9	2.89	10.0	1.8	0.61	0.95	0.56
		13.75	4.04	2.347	0.307	36.0	2.98	9.0	1.6	0.62	0.87	0.56
		11.50	3.35	2.260	0.220	32.3	3.11	8.1	1.3	0.63	0.79	0.58
		19.75	5.81	2.513	0.633	33.2	2.39	9.5	1.9	0.56	0.96	0.58
		17.25	5.07	2.408	0.528	30.2	2.44	8.6	1.6	0.57	0.87	0.56
C 6	7	14.75	4.34	2.303	0.423	27.2	2.50	7.8	1.4	0.57	0.79	0.54
		12.25	3.60	2.198	0.318	24.2	2.59	6.9	1.2	0.58	0.71	0.53
		9.80	2.85	2.090	0.210	21.1	2.72	6.0	0.98	0.59	0.63	0.55
		15.5	4.56	2.283	0.563	19.5	2.07	6.5	1.3	0.53	0.74	0.55
C 7	6	13.0	3.82	2.160	0.440	17.3	2.13	5.8	1.1	0.53	0.65	0.52
		10.5	3.09	2.038	0.318	15.1	2.21	5.0	0.88	0.53	0.57	0.50
		8.2	2.38	1.920	0.200	13.0	2.34	4.3	0.70	0.54	0.50	0.52
		11.5	3.38	2.037	0.477	10.4	1.75	4.2	0.82	0.49	0.54	0.51
C 8	5	9.0	2.65	1.890	0.330	8.9	1.83	3.6	0.64	0.49	0.45	0.48
		6.7	1.95	1.750	0.190	7.4	1.95	3.0	0.48	0.50	0.38	0.49
		7.25	2.13	1.725	0.325	4.6	1.46	2.3	0.44	0.46	0.35	0.46
C 9	4	6.25	1.84	1.652	0.252	4.2	1.51	2.1	0.38	0.45	0.32	0.46
		5.40	1.55	1.580	0.180	3.8	1.56	1.9	0.32	0.45	0.29	0.46
		6.0	1.76	1.602	0.362	2.1	1.08	1.4	0.31	0.42	0.27	0.46
C 72	3	5.0	1.47	1.504	0.264	1.8	1.12	1.2	0.25	0.42	0.24	0.44
		4.1	1.19	1.410	0.170	1.6	1.17	1.1	0.20	0.41	0.21	0.44

CHANNELS—ALLOWABLE UNIFORM LOAD IN POUNDS PER FOOT

(Carnegie Steel Co., Pocket Companion, 21st Edition)

Depth, Inches	Pounds per Foot	Span in Feet																				
		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
15	55	17000	12490	9560	7550	6120	5060	4250	3620	3120	2720	2390	2120	1890	1690	1530	1390	1260	1160	1060	980	910
	50	15910	11690	8950	7070	5730	4730	3980	3390	2920	2550	2240	1980	1770	1590	1430	1300	1180	1080	990	920	850
	45	14820	10890	8340	6590	5330	4410	3700	3160	2720	2370	2080	1850	1650	1480	1330	1210	1100	1010	930	850	790
	40	13730	10090	7720	6100	4940	4080	3430	2920	2520	2200	1930	1710	1530	1370	1240	1120	1020	930	860	790	730
	35	12640	9290	7110	5620	4550	3760	3160	2690	2320	2020	1780	1570	1400	1260	1140	1030	940	860	790	730	670
	33.9	12350	9070	6950	5490	4450	3670	3090	2630	2270	1980	1740	1540	1370	1230	1110	1010	920	840	770	710	660
13	50	14300	10510	8050	6360	5150	4260	3580	3050	2630	2290	2010	1780	1590	1430	1290	1170	1060	970	890	820	760
	45	13360	9810	7510	5940	4810	3970	3340	2850	2450	2140	1880	1660	1480	1330	1200	1090	990	910	840	770	710
	40	12410	9120	6980	5520	4470	3690	3100	2640	2280	1990	1750	1550	1380	1240	1120	1010	920	840	780	720	660
	37	11850	8710	6660	5270	4270	3530	2960	2520	2180	1900	1670	1480	1320	1180	1070	970	880	810	740	680	630
	35	11470	8430	6450	5100	4130	3410	2870	2440	2110	1840	1610	1430	1270	1140	1030	940	850	780	720	660	610
	32	10830	7960	6090	4810	3900	3220	2710	2310	1990	1730	1520	1350	1200	1080	970	880	810	740	680	620	580
12	40	9730	7150	5470	4320	3500	2890	2430	2070	1790	1560	1370	1210	1080	970	880	790	720	660	610	560	520
	35	8850	6500	4980	3940	3190	2630	2210	1890	1630	1420	1250	1100	980	880	800	720	660	600	550	510	470
	30	7980	5860	4490	3550	2870	2380	2000	1700	1470	1280	1120	1000	890	800	720	650	590	540	500	460	430
	25	7110	5220	4000	3160	2560	2120	1780	1520	1310	1140	1000	890	790	710	640	580	530	480	440	410	380
	20.7	6330	4650	3560	2810	2280	1880	1580	1350	1160	1010	890	780	700	630	570	520	470	430	400	360	340
10	35	6840	5030	3850	3040	2460	2040	1710	1460	1260	1100	960	850	760	680	620	560	510				
	30	6120	4490	3440	2720	2200	1820	1530	1300	1120	980	860	760	680	610	550	500	460				
	25	5390	3960	3030	2400	1940	1600	1350	1150	990	860	760	670	600	540	490	440	400				
	20	4670	3430	2620	2070	1680	1390	1170	990	860	750	660	580	520	470	420	380	350				
	15.3	3960	2910	2230	1760	1430	1180	990	840	730	630	560	490	440	400	360	320	290				
9	25	4660	3420	2620	2070	1680	1390	1160	990	860	750	650	580	520	460	420						
	20	4000	2940	2250	1780	1440	1190	1000	850	740	640	560	500	450	400	360						
	15	3350	2460	1880	1490	1210	1000	840	710	620	540	470	420	370	330	300						
	13.4	3120	2290	1750	1380	1120	930	780	660	570	500	440	390	350	310	280						

Loads below dotted horizontal lines will produce excessive deflection.

CHANNELS—ALLOWABLE UNIFORM LOAD IN POUNDS PER FOOT

(Carnegie Steel Co., Pocket Companion, 21st Edition)

Depth, Inches	Pounds per Foot	Span in Feet																			
		2	2½	3	3½	4	4½	5	5½	6	6½	7	8	9	10	11	12	13	14	15	16	17	18
	21.25	31840	20380	14150	10400	7960	6290	5090	4210	3540	3010	2600	1990	1570	1270	1050	880	750	650	570	500	440	390
	18.75	29230	18710	12990	9540	7310	5770	4680	3860	3250	2770	2390	1830	1440	1170	970	810	690	600	520	460	410	360
8	16.25	26610	17030	11820	8690	6650	5260	4260	3520	2960	2520	2170	1660	1310	1060	880	740	630	540	470	420	370	330
	13.75	24000	15360	10670	7840	6000	4740	3840	3170	2670	2270	1960	1500	1190	960	790	670	570	490	430	370	330	300
	11.50	17600	13780	9570	7030	5380	4250	3450	2850	2390	2040	1760	1350	1060	860	710	600	510	440	380	340	300	270
	19.75	25280	16180	11230	8250	6320	4990	4040	3340	2810	2390	2060	1580	1250	1010	840	700	600	520	450	400		
	17.25	22990	14710	10220	7510	5750	4540	3680	3040	2550	2180	1880	1440	1140	920	760	640	540	470	410	360		
7	14.75	20700	13250	9200	6760	5180	4090	3310	2740	2300	1960	1690	1290	1020	830	680	580	490	420	370	320		
	12.25	18410	11780	8180	6010	4600	3640	2950	2430	2050	1740	1500	1150	910	740	610	510	440	380	330	290		
	9.80	14700	10280	7140	5250	4020	3170	2570	2120	1790	1520	1310	1000	790	640	530	450	380	330	290	250		
	15.5	17360	11110	7720	5670	4340	3430	2780	2300	1930	1640	1420	1090	860	690	570	480	410	350				
	13.0	15400	9860	6840	5030	3850	3040	2460	2040	1710	1460	1260	960	760	620	510	430	360	310				
6	10.5	13440	8600	5970	4390	3360	2650	2150	1780	1490	1270	1100	840	660	540	440	370	320	270				
	8.2	11550	7390	5130	3770	2890	2280	1850	1530	1280	1090	940	720	570	460	380	320	270	240				
	11.5	11100	7100	4930	3620	2770	2190	1780	1470	1230	1050	910	690	550	440	370	310						
5	9.0	9460	6060	4210	3090	2370	1870	1510	1250	1050	900	770	590	470	380	310	260						
	6.7	7910	5060	3520	2580	1980	1560	1270	1050	880	750	650	490	390	320	260	220						
	7.25	6090	3900	2710	1990	1520	1200	980	810	680	580	500	380	300	240								
4	6.25	5570	3570	2480	1820	1390	1100	890	740	620	530	460	350	280	220								
	5.40	5060	3240	2250	1650	1260	1000	810	670	560	480	410	320	250	200								
	6.0	3680	2350	1630	1200	920	730	590	490	410	350	300											
3	5.0	3290	2100	1460	1070	820	650	530	430	370	310	270											
	4.1	2910	1860	1290	950	730	570	470	380	320	280	240											

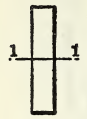
Loads within heavy horizontal lines are maximum loads for web shear.

Loads below dotted horizontal lines will produce excessive deflection.

MOMENT OF INERTIA OF RECTANGLES

Carnegie Steel Co., Pocket Companion, 21st Edition)

In Widths from ¼ to ⅝ Inch and 1 Inch



Neutral Axis Through Center Normal to Depth

To obtain the Moment of Inertia of any rectangle, multiply the tabular value for its depth by its width in inches. For deeper rectangles of tabular thickness, multiply the tabular values for half their depth by 8; or for one-third their depth by 27, etc.

Depth, Inches	Width, Inches							
	¼	5/16	⅜	7/16	½	9/16	⅝	1
1	.021	.026	.031	.037	.042	.047	.052	.083
2	.167	.208	.250	.292	.333	.375	.417	.667
3	.563	.703	.844	.984	1.125	1.266	1.406	2.250
4	1.333	1.667	2.000	2.333	2.667	3.000	3.333	5.333
5	2.604	3.255	3.906	4.557	5.208	5.859	6.510	10.417
6	4.500	5.625	6.750	7.875	9.000	10.125	11.250	18.000
7	7.146	8.932	10.719	12.505	14.292	16.078	17.865	28.583
8	10.667	13.333	16.000	18.667	21.333	24.000	26.667	42.667
9	15.188	18.984	22.781	26.578	30.375	34.172	37.969	60.750
10	20.833	26.042	31.250	36.458	41.667	46.875	52.083	83.333
11	27.729	34.662	41.594	48.526	55.458	62.391	69.323	110.917
12	36.000	45.000	54.000	63.000	72.000	81.000	90.000	144.000
13	45.771	57.214	68.656	80.099	91.542	102.984	114.427	183.083
14	57.167	71.458	85.750	100.042	114.333	128.625	142.917	228.667
15	70.313	87.891	105.469	123.047	140.625	158.203	175.781	281.250
16	85.333	106.667	128.000	149.333	170.667	192.000	213.333	341.333
17	102.354	127.943	153.531	179.120	204.708	230.297	255.885	409.417
18	121.500	151.875	182.250	212.625	243.000	273.375	303.750	486.000
19	142.896	178.620	214.344	250.068	285.792	321.516	357.240	571.583
20	166.667	208.333	250.000	291.667	333.333	375.000	416.667	666.667
21	192.938	241.172	289.406	337.641	385.875	434.109	482.344	771.750
22	221.833	277.292	332.750	388.208	443.667	499.125	554.583	887.333
23	253.479	316.849	380.219	443.589	506.958	570.328	633.698	1013.917
24	288.000	360.000	432.000	504.000	576.000	648.000	720.000	1152.000
25	325.521	406.901	488.281	569.662	651.042	732.422	813.802	1302.083
26	366.167	457.708	549.250	640.792	732.333	823.875	915.417	1464.667
27	410.063	512.578	615.094	717.609	820.125	922.641	1025.156	1640.250
28	457.333	571.667	686.000	800.333	914.667	1029.000	1143.333	1829.333
29	508.104	635.130	762.156	889.182	1016.208	1143.234	1270.260	2032.417
30	562.500	703.125	843.750	984.375	1125.000	1265.625	1406.250	2250.000
32	682.667	853.333	1024.000	1194.667	1365.333	1536.000	1706.667	2730.667
34	818.833	1023.542	1228.250	1432.958	1637.667	1842.375	2047.083	3275.333
36	972.000	1215.000	1458.000	1701.000	1944.000	2187.000	2430.000	3888.000
38	1143.167	1428.958	1714.750	2000.542	2286.333	2572.125	2857.917	4572.667
40	1333.333	1666.667	2000.000	2333.333	2666.667	3000.000	3333.333	5333.333
42	1543.500	1929.375	2315.250	2701.125	3087.000	3472.875	3858.750	6174.000
44	1774.667	2218.333	2662.000	3105.667	3549.333	3993.000	4436.667	7098.667
46	2027.833	2534.792	3041.750	3548.708	4055.667	4562.625	5069.583	8111.333
48	2304.000	2880.000	3456.000	4032.000	4608.000	5184.000	5760.000	9216.000
50	2604.167	3255.208	3906.250	4557.292	5208.333	5859.375	6510.417	10416.667
52	2929.333	3661.667	4394.000	5126.333	5858.667	6591.000	7323.333	11717.333
54	3280.500	4100.625	4920.750	5740.875	6561.000	7381.125	8201.250	13122.000
56	3658.667	4573.333	5488.000	6402.667	7317.333	8232.000	9146.667	14634.667
58	4064.833	5081.042	6097.250	7113.458	8129.667	9145.875	10162.083	16259.333
60	4500.000	5625.000	6750.000	7875.000	9000.000	10125.000	11250.000	18000.000

MOMENTS OF INERTIA OF RECTANGLES

(Carnegie Steel Co., Pocket Companion, 21st Edition)

In Widths of 1 Inch

Neutral Axis Through Center Normal to Depth

To obtain the Moment of Inertia of any rectangle, multiply the tabular value for its depth by its width in inches. For deeper rectangles of tabular thickness, multiply the tabular values for half their depth by 8; or for one-third their depth by 27, etc.

Depth, Inches	$I_{1\text{-}1}$ Inches^4	Depth, Inches	$I_{1\text{-}1}$ Inches^4	Depth, Inches	$I_{1\text{-}1}$ Inches^4	Depth, Inches	$I_{1\text{-}1}$ Inches^4	Depth, Inches	$I_{1\text{-}1}$ Inches^4	Depth, Inches	$I_{1\text{-}1}$ Inches^4
0	.000	6	18.000	12	144.000	18	486.000	24	1152.000	30	2250.000
1/8	.000	1/8	19.149	1/8	148.547	1/8	496.195	1/8	1170.094	1/8	2278.243
1/4	.001	1/4	20.345	1/4	153.189	1/4	506.533	1/4	1188.376	1/4	2306.721
3/8	.004	3/8	21.590	3/8	157.926	3/8	517.012	3/8	1206.848	3/8	2335.434
1/2	.010	1/2	22.885	1/2	162.760	1/2	527.635	1/2	1225.510	1/2	2364.385
5/8	.020	5/8	24.231	5/8	167.692	5/8	538.403	5/8	1244.364	5/8	2393.575
3/4	.035	3/4	25.629	3/4	172.723	3/4	549.317	3/4	1263.410	3/4	2423.004
7/8	.056	7/8	27.079	7/8	177.853	7/8	560.376	7/8	1282.650	7/8	2452.674
1	.083	7	28.583	13	183.083	19	571.583	25	1302.083	31	2482.583
1/8	.119	1/8	30.142	1/8	188.416	1/8	582.939	1/8	1321.713	1/8	2512.737
1/4	.163	1/4	31.757	1/4	193.850	1/4	594.444	1/4	1341.538	1/4	2543.132
3/8	.217	3/8	33.428	3/8	199.389	3/8	606.099	3/8	1361.561	3/8	2573.771
1/2	.281	1/2	35.156	1/2	205.031	1/2	617.906	1/2	1381.781	1/2	2604.656
5/8	.358	5/8	36.944	5/8	210.779	5/8	629.866	5/8	1402.202	5/8	2635.787
3/4	.447	3/4	38.790	3/4	216.634	3/4	641.978	3/4	1422.821	3/4	2667.165
7/8	.549	7/8	40.698	7/8	222.596	7/8	654.245	7/8	1443.644	7/8	2698.792
2	.667	8	42.667	14	228.667	20	666.667	26	1464.667	32	2730.667
1/8	.800	1/8	44.698	1/8	234.847	1/8	679.245	1/8	1485.893	1/8	2762.792
1/4	.949	1/4	46.793	1/4	241.137	1/4	691.840	1/4	1507.324	1/4	2795.168
3/8	1.116	3/8	48.952	3/8	247.538	3/8	704.874	3/8	1528.961	3/8	2827.797
1/2	1.302	1/2	51.177	1/2	254.052	1/2	717.927	1/2	1550.802	1/2	2860.677
5/8	1.507	5/8	53.468	5/8	260.679	5/8	731.141	5/8	1572.851	5/8	2893.812
3/4	1.733	3/4	55.827	3/4	267.421	3/4	744.514	3/4	1595.108	3/4	2927.202
7/8	1.980	7/8	58.254	7/8	274.277	7/8	758.051	7/8	1617.575	7/8	2960.849
3	2.250	9	60.750	15	281.250	21	771.750	27	1640.250	33	2994.750
1/8	2.543	1/8	63.317	1/8	288.340	1/8	785.613	1/8	1663.136	1/8	3028.911
1/4	2.861	1/4	65.954	1/4	295.548	1/4	799.652	1/4	1686.236	1/4	3063.329
3/8	3.204	3/8	68.665	3/8	302.875	3/8	813.836	3/8	1709.547	3/8	3098.009
1/2	3.573	1/2	71.448	1/2	310.323	1/2	828.198	1/2	1733.073	1/2	3132.948
5/8	3.970	5/8	74.305	5/8	317.891	5/8	842.727	5/8	1756.814	5/8	3168.150
3/4	4.395	3/4	77.238	3/4	325.582	3/4	857.426	3/4	1780.770	3/4	3203.614
7/8	4.849	7/8	80.247	7/8	333.396	7/8	872.294	7/8	1804.943	7/8	3239.341
4	5.333	10	83.333	16	341.333	22	887.333	28	1829.333	34	3275.333
1/8	5.849	1/8	86.498	1/8	349.396	1/8	902.545	1/8	1853.943	1/8	3311.592
1/4	6.397	1/4	89.741	1/4	357.585	1/4	917.928	1/4	1878.773	1/4	3348.117
3/8	6.978	3/8	93.064	3/8	365.900	3/8	933.486	3/8	1903.823	3/8	3384.909
1/2	7.594	1/2	96.469	1/2	374.344	1/2	949.219	1/2	1929.094	1/2	3421.969
5/8	8.244	5/8	99.955	5/8	382.916	5/8	965.127	5/8	1954.588	5/8	3459.300
3/4	8.931	3/4	103.525	3/4	391.618	3/4	981.212	3/4	1980.305	3/4	3496.900
7/8	9.655	7/8	107.178	7/8	400.452	7/8	997.475	7/8	2006.249	7/8	3534.772
5	10.417	11	110.917	17	409.417	23	1013.917	29	2032.417	35	3572.917
1/8	11.218	1/8	114.741	1/8	418.515	1/8	1030.538	1/8	2058.811	1/8	3611.334
1/4	12.059	1/4	118.652	1/4	427.746	1/4	1047.340	1/4	2085.434	1/4	3650.027
3/8	12.941	3/8	122.652	3/8	437.113	3/8	1064.323	3/8	2112.285	3/8	3688.994
1/2	13.865	1/2	126.740	1/2	446.615	1/2	1081.490	1/2	2139.365	1/2	3728.240
5/8	14.832	5/8	130.918	5/8	456.253	5/8	1098.839	5/8	2166.676	5/8	3767.763
3/4	15.843	3/4	135.186	3/4	466.030	3/4	1116.374	3/4	2194.218	3/4	3807.561
7/8	16.898	7/8	139.547	7/8	475.945	7/8	1134.094	7/8	2221.992	7/8	3847.641
6	18.000	12	144.000	18	486.000	24	1152.000	30	2250.000	36	3888.000

BOLT HEADS AND NUTS, DIMENSIONS IN INCHES

(Carnegie Steel Co., Pocket Companion, 21st Edition)

AMERICAN BRIDGE COMPANY STANDARD

Diameter of Bolt, Inches	HEAD					Diameter of Bolt, Inches	NUT				
	Hexagonal		Hex. or Square	Square			Hexagonal		Hex. or Square	Square	
	Diameter			Diameter			Diameter			Diameter	
	Long	Short	Height	Long	Short		Long	Short	Height	Long	Short
1/4	5/8	1/2	1/4	11/16	1/2	1/4	5/8	1/2	1/4	11/16	1/2
3/8	13/16	11/16	3/8	1	11/16	3/8	13/16	11/16	3/8	1	11/16
1/2	1	7/8	7/16	1 1/4	7/8	1/2	1	7/8	1/2	1 1/4	7/8
5/8	1 1/4	1 1/16	9/16	1 1/2	1 1/16	5/8	1 1/4	1 1/16	5/8	1 1/2	1 1/16
3/4	1 7/16	1 1/4	5/8	1 13/16	1 1/4	3/4	1 7/16	1 1/4	3/4	1 13/16	1 1/4
7/8	1 11/16	1 7/16	3/4	2 1/16	1 7/16	7/8	1 11/16	1 7/16	7/8	2 1/16	1 7/16
1	1 7/8	1 5/8	13/16	2 5/16	1 5/8	1	1 7/8	1 5/8	1	2 5/16	1 5/8
1 1/8	2 1/8	1 13/16	15/16	2 9/16	1 13/16	1 1/8	2 1/8	1 13/16	1 1/8	2 9/16	1 13/16
1 1/4	2 5/16	2	1	2 13/16	2	1 1/4	2 5/16	2	1 1/4	2 13/16	2
1 3/8	2 9/16	2 3/16	1 1/16	3 1/8	2 3/16	1 3/8	2 9/16	2 3/16	1 3/8	3 1/8	2 3/16
1 1/2	2 3/4	2 3/8	1 3/16	3 3/8	2 5/16	1 1/2	2 3/4	2 5/16	1 1/2	3 5/16	2 5/16
1 5/8	3	2 9/16	1 5/16	3 5/8	2 9/16	1 5/8	3	2 9/16	1 5/8	3 5/8	2 9/16
1 3/4	3 1/8	2 3/4	1 3/8	3 7/8	2 3/4	1 3/4	3 3/16	2 3/4	1 3/4	3 7/8	2 3/4
1 7/8	3 7/16	2 15/16	1 1/2	4 1/16	2 15/16	1 7/8	3 7/16	2 15/16	1 7/8	4 1/16	2 15/16
2	3 5/8	3 1/8	1 9/16	4 7/16	3 1/8	2	3 5/8	3 1/8	2	4 7/16	3 1/8
2 1/4	4 1/16	3 1/2	1 3/4	4 15/16	3 1/2	2 1/4	4 1/16	3 1/2	2 1/4	4 15/16	3 1/2
2 1/2	4 1/2	3 7/8	1 15/16	5 1/2	3 7/8	2 1/2	4 1/2	3 7/8	2 1/2	5 1/2	3 7/8
2 3/4	4 15/16	4 1/4	2 1/8	6	4 1/4	2 3/4	4 15/16	4 1/4	2 3/4	6	4 1/4
3	5 3/8	4 5/8	2 5/16	6 9/16	4 5/8	3	5 3/8	4 5/8	3	6 9/16	4 5/8
3 1/4	5 13/16	5	2 1/2	7 1/16	5	3 1/4	5 13/16	5	3 1/4	7 1/16	5
3 1/2	6 1/4	5 3/8	2 11/16	7 5/8	5 3/8	3 1/2	6 1/4	5 3/8	3 1/2	7 5/8	5 3/8

BOLTS WITH SQUARE HEADS AND NUTS

(Carnegie Steel Co., Pocket Companion, 21st Edition)

AMERICAN BRIDGE COMPANY STANDARD

WEIGHT IN POUNDS PER 100 BOLTS

Length Under Head, Inches	Diameter of Bolt, Inches								
	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
1	4	7	11	15	22	37	56		
1 1/4	4	7	11	16	23	39	59		
1 1/2	5	8	12	17	24	41	62		
1 3/4	5	8	13	18	26	43	64		
2	5	9	14	19	27	45	67	101	144
2 1/4	6	9	15	20	28	47	71	104	150
2 1/2	6	10	15	21	30	49	74	109	155
2 3/4	6	10	16	22	31	51	77	113	161
3	7	11	17	24	33	54	80	117	167
3 1/2	7	12	18	25	35	58	86	126	178
4	8	13	20	28	38	62	92	134	189
4 1/2	9	14	21	30	41	66	98	142	198
5	10	15	23	32	43	71	104	151	209
5 1/2	10	16	25	34	46	75	111	159	220
6	11	17	26	36	49	79	117	168	232
6 1/2			28	38	52	84	123	176	243
7			29	40	55	88	129	185	254
7 1/2			31	42	57	92	136	193	265
8			32	45	60	97	142	202	276
9			34	49	65	105	154	218	298
10				53	71	114	167	235	320
12				61	82	131	192	269	364
14					93	148	217	303	409
Per Inch Additional	1.4	2.2	3.1	4.3	5.6	8.7	12.5	17.0	22.3

BOLTS WITH HEXAGON HEADS AND NUTS

(Carnegie Steel Co., Pocket Companion, 21st Edition)

AMERICAN BRIDGE COMPANY STANDARD

WEIGHT IN POUNDS PER 100 BOLTS

Length Under Head, Inches	Diameter of Bolt, Inches					Length Under Head, Inches	Diameter of Bolt, Inches				
	½	⅝	¾	⅞	1		½	⅝	¾	⅞	1
1	19	33	52			8	58	92	137	194	264
1¼	20	34	54			8½	60	96	143	202	274
1½	22	36	57			9	63	100	149	210	285
1¾	23	38	60			9½	66	105	156	219	296
2	24	40	63	93	132	10	68	109	162	227	307
2¼	26	43	66	97	137	10½	71	114	168	236	318
2½	27	45	69	101	143	11	74	118	174	244	329
2¾	29	47	72	105	148	11½	77	122	181	253	341
3	30	49	75	109	154	12	80	127	187	261	352
3¼	31	51	78	114	160	12½	82	131	193	270	363
3½	33	54	82	118	165	13	85	135	199	278	374
3¾	34	56	85	122	171	13½	88	139	206	287	385
4	35	58	88	126	176	14	91	144	212	295	396
4¼	37	60	90	130	180	14½	93	148	218	304	407
4½	38	62	94	134	186	15	96	152	225	312	418
4¾	39	64	97	138	191	15½	99	157	231	321	430
5	41	66	100	143	197	16	102	161	237	329	441
5¼	42	68	103	147	202	16½	105	165	243	338	452
5½	44	71	106	151	208	17	107	170	250	346	463
5¾	45	73	109	156	213	17½	110	174	256	355	474
6	46	75	112	160	219	18	113	177	262	364	485
6¼	48	77	115	164	225	18½	116	183	268	372	496
6½	49	79	119	168	230	19	119	187	275	381	507
6¾	51	81	122	173	236	19½	121	191	281	389	519
7	52	84	125	177	241	20	124	196	287	398	530
7¼	53	86	128	181	247						
7½	55	88	131	185	252						
7¾	56	90	134	190	258						
Per Inch Additional	5.6	8.7	12.5	17.0	22.3	Per Inch Additional	5.6	8.7	12.5	17.0	22.3

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VOLUME 1
VOLUME 3
VOLUME 3
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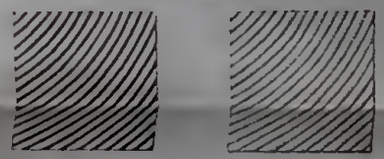
OF KNOTS ON STRENGTH GREATEST IN VOLUMES 1 AND 2

FIG. 2

FIG. 8

MEASUREMENT OF SUMMERWOOD

ONE-THIRD SUMMERWOOD



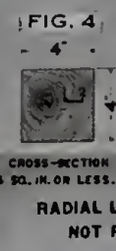
SHARP CONTRAST — ACCEPTED

POOR CONTRAST — REJECTED

PITH PRESENT OR LOCATED

RADIAL LINE OF 5 IN. PRESENT

FIG. 3



CROSS-SECTION 16 SQ. IN. OR LESS.

FIG. 4

OVER 16 SQ. IN.

FIG. 5

RADIAL LINE OF 5 IN. NOT PRESENT

PITH NOT PRESENT

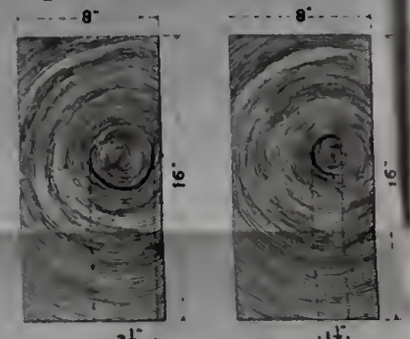
OVER 3 IN. THICK

FIG. 6

3 IN. THICK OR LESS

FIG. 7

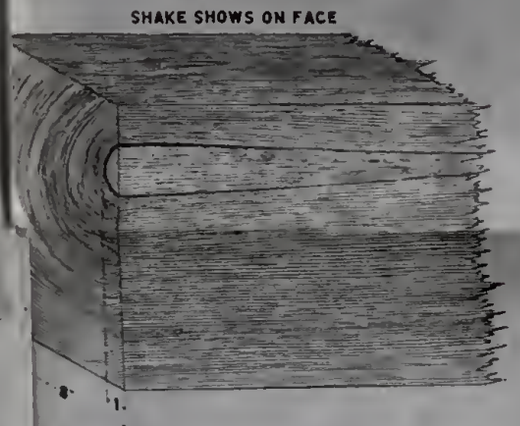
RING-SHAKES



LOSS OF STRENGTH DUE TO SHAKES GREATEST WHEN SHAKES AT MIDDLE OF HEIGHT

FIG. 1

FIG. 10



CHECKS

LOSS OF STRENGTH DUE TO CHECKS GREATEST WHEN CHECKS AT MIDDLE OF HEIGHT

FIG. 11

MEASUREMENT OF KNOTS

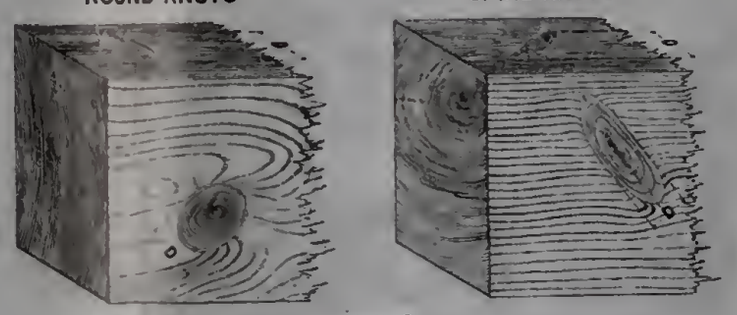
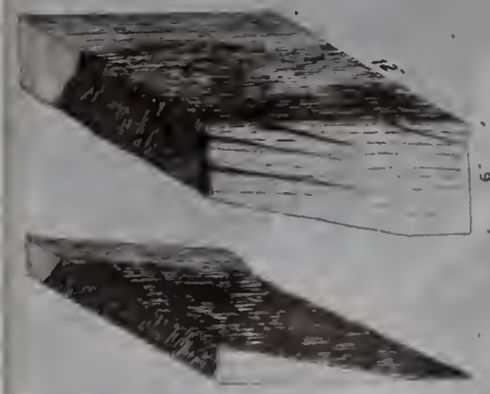


FIG. 9

DIAGONAL GRAIN



DIRECTION OF GRAIN SHOWN BY SPLIT, CHECKS AND PITCH-STREAKS. SLOPE GREATER THAN 1 IN 20 REJECTED IF IN VOLUME ONE.

FIG. 12

U.S. FOREST PRODUCTS LABORATORY
MADISON, WIS. MAY, 1915

SNAKE SHOWS ON FACE
REJECTED

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